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THE BIOLOGY OF THE MOSQUITO *AEDES ATROPALPUS* COQUILLETT

ROBERT A. HEDEEN[1]

INTRODUCTION

The adult male and female of the mosquito *Aedes atropalpus* Coquillett were described in 1902 from specimens collected in Virginia, Maryland, Pennsylvania, and New Hampshire. (Coquillett). Dyar (1902) described the fourth instar larva and egg, and in 1903 briefy noted certain features of the younger instar larvae. The species was originally assigned to the genus *Culex,* but was transferred to *Aedes* in 1906 (Dyar 1906).

This mosquito is of particular interest biologically because of its specialized breeding habit. It breeds principally in rock holes or depressions containing water, and so far as could be determined, has, until the present time, been reported only from this type of breeding environment. This choice of breeding sites, and the white-striped tarsi has caused the species to be called the white-banded rock hole mosquito. The females actively attack human beings, and they are frequently very troublesome around their breeding areas. When many rock holes filled with water are made available by rains or the overflow of streams, the species may become quite abundant and annoying for a short time. However, due to the usual deficiency of suitable breeding places the mosquito never occurs in large numbers over a long period of time.

Although it has been known for many years that *Aedes atropalpus* will attack man, little was known of the possible importance of the mosquito in disease transmission until 1939. At this time, workers at the Harvard Medical School demonstrated by laboratory experiments that the species can transmit the eastern variety of equine encephalitis (Carpenter et al 1946). Later it was found that this mosquito is also a vector of *Plasmodium gallinaceum,* a variety of malaria found in birds and chickens. (Trembley 1946). Although this species is probably not very important as a general vector of either of these diseases because of its specialized breeding habits, it is possible that it might assume an important role under some conditions.

Aedes atropalpus is rather widely distributed over North and Central America. It has been reported from the following states: Arkansas, Arizona, Connecticut, District of Columbia, Maine, Maryland, Massachusetts, Minnesota, Tennessee, Oklahoma, New Hampshire, New Jersey, New Mexico, New York, Pennsylvania, Rhode Island, Texas, Vermont, and Wisconsin. In addition to the above localities it is known to occure in Southern Canada, Mexico, and Central America. (Carpenter et al 1946).

METHODS

In this study of the mosquito, *Aedes atropalpus,* particular attention was paid to the following points:

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1. Methods for rearing and study in the laboratory.
2. Distribution and associated species.
3. Breeding sites, including place of egg deposition.
4. Food of the larvae.
5. Reaction of the larvae to light.
6. Reaction of the several larval instars when denied access to atmospheric oxygen.
7. General egg biology including the irregular hatching pattern of the egg when subjected to alternating periods of drying and exposure to water.
8. Effect of temperature on the hatching of the eggs.

The majority of the specimens used in this study were obtained in the vicinity of Austin, Travis County, Texas, but other large collections have been made by the writer and his associates at Round Rock, Texas, in Williamson County, Fredericksburg, Texas, in Gillespie County, Junction in Kimble County, Sheffield, in Pecos County, and San Antonio, Texas, in Bexar County. The collections that were made near Austin were all obtained from two rather small rock holes on a creek a few miles from the city. Many other suitable breeding places were located in this area, but the species was never taken in any other locality in Travis County. This fact again emphasizes the extremely specialized conditions under which *Aedes atropalpus* normally breeds in the central region of Texas.

Specimens were obtained for study from rock holes that were naturally filled with water, but on several occasions when the rock holes were dry, larvae were obtained by adding water to the holes from the nearby creek. In all cases the water was strained through a finely meshed net to eliminate the possibility of introducing eggs or larvae from the creek. Females deposited eggs in the laboratory only twice, but as large numbers of eggs were obtained each time many first instar larvae were obtained.

Adult mosquitoes were kept in the laboratory in a wire cage approximately twenty inches by eighteen inches by eighteen inches. There were two openings, normally kept closed, through which the arms could be inserted upon which the females could feed. In order to obtain a high humidity within the cage, moistened towels were placed over the top of the cage. A rock containing a large hole and placed in a dish of water was provided for oviposition as well as a finger bowl of moist sand. Adult females were offered a blood meal at least twice a day, and males were fed a mixture of corn syrup and distilled water. It was observed that the food provided for the males was readily accepted by the females. Trembley (1947) believes that copulation takes place at night. This is probably correct, for the rearing cages were observed at all times except night, and copulation was never observed.

Larvae that were collected in nature were brought into the laboratory and placed in large enamel rearing pans. In some cases they were fed powdered yeast or ground dog food, and in other instances fresh water algae were provided. It was found that some mature larvae did not pupate, while others of the same brood, that were being reared in another pan, pupated very soon after reaching the fourth instar. A deficient food supply was probably responsible for this situation since pupation was quickly accomplished when either artificial or natural food was introduced.

This study was begun in September, 1948, and was continued until August, 1949. The writer estimates that well over two thousand *A. atropalpus* were brought into the laboratory for study during the span of the investigation.

GENERAL BIOLOGY

As stated before, the preferred breeding place of this mosquito is in the rock holes that occur along the edges of streams and rivers, and which become filled with water after rains or when the stream or river is at a high level. As far as can be determined *A. atropalpus* has never been previously reported from any other type of breeding place. This writer has recovered this species from tree holes on two occasions and from an artificial container once. Both of the tree hole collections were made from cavities in the common hackberry, *Celtis Mississippiensis* L. in the vicinity of Sheffield, Texas (Pecos, County). In one of the collections larvae of various instars were taken from a cavity containing water. On the other occasion dry material from a different cavity was brought into the laboratory and flooded with pond water. Within a short time first instar *A. atropalpus* appeared. Approximately thirty larvae were obtained from the dry material. At the instance of the collection from the artificial container, that was located by a store in Medina County, several fourth instar larvae and pupae were recovered. This indicates that when the much preferred rock holes are not available for egg deposition, as was the case here, other places may be resorted to for breeding purposes.

During the course of this study many other species of mosquitoes were found in association with *A. atropalpus*. The most prevalent of these associated species is *Culex tarsalis* Coquillett, the most common mosquito in the region of Central Texas. Other members of the genus *Culex* that are frequently found in association with the white-banded rock hole mosquito are *Culex quinquefasciatus* Say and *Culex restuans* Theobald. *Psorophora signipennis* Coq. is another common species in this area that is frequently found to be an associated species. *P. signipennis* exhibits some preference for breeding in rock holes, but it is commonly found in other places. *Psorophora confinnis* Lynch Arribalzaga is another associated species that is frequently found in rock holes. This species does not show any degree of preference, however, as it is more often found in other situations, even when rock holes are very near. *Anopheles punctipennis* Say has been found to be another associated species as is *Anopheles pseudopunctipennis pseudopunctipennis* Theobald. These last two species breed only incidentally in rock holes. In the collections made from the tree holes the following species were found to be included with *A. atropalpus: Aedes triseriatus* Say; *Aedes zoosophus* Dyar and Knab; *Orthopodomyia alba* Baker; *Orthopodomyia signifera* Coquillet. In the collection from the artificial container *Aedes aegypti* L. was found with *A. atropalpus*.

Aedes atropalpus has been collected by the writer from February to November, and the evidence indicates that the breeding season may extend into Dcember if warm temperature prevails. On the other hand, the first generation of the spring may be delayed until the middle of March if the winter has been exceptionally long and cold. The winter months are passed in the egg stage, and once the eggs hatch in the spring there are several gen-

erations during the warm months of the year. During the winter months the rock holes used by *A. atropalpus* in the spring and summer are occupied by larvae of the mosquitoes *Culiseta inornata* Williston and *Culex tarsalis*.

LARVAL FOOD

It is generally known that mosquito larvae feed on aquatic organisms. Barber (1928) states that little food selection is shown by mosquito larvae and that almost any aquatic organism that is small enough to be overcome may be eaten. The writer has found this to be generally true in regard to the animal and small plant food taken by *A. atropalpus*, but a definite preference in regard to some of the common colonial fresh water algae has been observed.

If the common alga, *Spirogyra*, is introduced into a culture of *atropalpus* the larvae will come from all corners of the container and begin to feed. It has been noted that the blue-green alga, *Oscillatoria*, also attracts the larvae, but not to such a degree as *Spirogyra*. On the other hand, larvae are not attracted to *Cladophora*, a branched colonial green alga. Larvae have been observed to take this alga many times but only after having come in contact with it accidentally or after having been placed close to it by means of a pipette. Another green colonial alga, *Oedogonium*, also offers no degree of attraction and larvae have been observed to feed upon it only now and then.

In order to determine other organisms that may normally be used for food by the larvae, many dissections of the intestines of specimens collected in nature were made. This operation is quite simple, for the intestine may be readily withdrawn from the body by pulling gently on the anal segment with a dissecting needle while the head is held fast with another needle. Some of the organisms, both plant and animal, frequently found in the intestine of this species were: *Diatoms; Desmids; Pediastrum; Gonium; Euglena; Paramecium, Stentor, Blepharisma, Euplotes,* and several species of rotifers. Various small worms were also found. Many small crustaceans were also found with the Nauplius larval form of *Cyclops*, and *Daphnia* being the most prevalent.

In the course of examination in the laboratory the larvae were also fed artificial food. The artificial food most frequently used was powdered yeast. It was found that this was partciularly suited to first and second instar larvae which are quite small and which probably have a difficult task finding natural food in the laboratory that is small enough to feed upon. Powdered dog food was also used as an artificial food, but it was not as readily eaten as the powdered yeast.

Larval *A. atropalpus* are definitely omnivorus feeders although preferences for the aforementioned fresh water algae have been observed. It is believed that the larval stage in nature does not limit itself to any particular diet but uses whatever food is available.

REACTION OF LARVAE TO LIGHT:

It was observed as early as 1903 by Dyar (Dyar 1903) that the larva of *A. atropalpus* will remain below the water's surface longer than the larvae of most species. The writer has noted that the larvae are secretive in their habits and are quite frequently found under leaves and other organic debris that are usually found on the bottoms of the rock holes they inhabit. Since larvae

are frequently found in rock holes exposed to the direct rays of sun, it was thought possible that a negative reaction to light might be an explanation for their rather peculiar behavior. Consequently, experiments were performed to determine whether they were positively or negatively phototropic.

This work was conducted with a large number of fourth instar larvae that had been collected several days before from rock holes at Junction, Texas. Most of the larvae were congregated at one end of the pan in which they were being reared. A reading lamp containing a thirty watt bulb was introduced near the end of the pan in which they were congregated, and immediately they began moving toward the opposite end. When the light was moved to the end toward which they were migrating they started returning to their original position. A light was then placed at each end of the pan and a piece of cardboard placed over the middle. Within three minutes practically all the larvae had congregated in a position directly beneath the piece of cardboard. After these tests were performed on *A. atrpalpus, Aedes trivittatus* Coquillett was subjected to the same conditions. *A. trivittatus* showed no response, neither positive nor negative, to the lights. It should be noted that *A. trivittatus* has not been observed to remain beneath the water for long periods of time or to seek out places of refuge beneath leaves or organic material on the bottom.

It should be noted that an even stronger negative reaction to light was observed when larval *A. atropalpus* were exposed to the direct rays of the sun. Many larvae were placed in a pan which had one end covered by a piece of cardboard and set in direct sunlight. All of the larvae in the unshaded portion of the pan immediately began moving toward the shaded area. Within thirty seconds they all were observed to be within the area covered by the cardboard. At this time the cardboard was removed to the other end of the pan, and the larvae immediately started moving toward this end. The cardboard was then placed over the center of the pan, and the larvae quickly congregated in this area

This negative phototropic reaction, which shows that larvae of *A. atropalpus* prefer areas of a lesser concentration of light to areas of greater concentration, is submitted as a possible explanation of why this species spends long periods of time below the water's surface and is frequently observed under various objects found on the bottom.

REACTION OF LARVAE TO LACK OF ATMOSPHERIC OXYGEN:

As was pointed out earlier the larvae of *Aedes atropalpus* have frequently been observed to spend long periods of time beneath the surface of the water. It was, therefore, believed desirable to determine how long larvae of this species could remain below the surface of the water using only the oxygen that could be obtained from the water by means of the anal gills and the body surface.

In order to arrive at an answer to the above question, two vials were filled with water and were inverted in a pan of water in such a manner that there was no free oxygen available within the vial. In one of the vials first and second instar larvae were placed, and in the other fourth instar, or mature larvae, were placed. A careful check was then made of the two vials at frequent intervals of time. The first and second instar larvae were observed to

rise frequently to the surface of the water, which would normally be at the top of the vial, and remain at the top of the vial for some time, apparently trying to reach free oxygen. On the other hand, fourth instar larvae rose to the top of the vial only infrequently. They would usually not remain here long, but would return to the bottom and resume feeding.

From the preliminary observations that were made it appeared that the early instar larvae were not too well adapted to spend long periods of time beneath the surface of the water, while the mature larvae were better suited to do so. This was indicated by the fact that the first and second instar larvae were observed to die after approximately ten hours without access to atmospheric oxygen while the mature larvae lived about ten hours longer. It is believed that the trachae which supply the anal gills of the early stages are not too developed.

Dyar (1903) states that the anal gills of the early stages are well supplied with trachae, but the anal gills of the early instar larvae examined by the writer failed to confirm Dyar's observation. The anal gills of the mature larva, however, have been observed to be well supplied with trachae, and this is probably the reason they are able to remain beneath the surface of the water for long lengths of time.

Although fourth instar larvae are able to live for approximately twenty hours without access to atmospheric oxygen, it is believed that this capacity is the principal reason why the larvae normally stay beneath the surface longer than those of many other species of mosquitoes. This same type of experiment has been performed with larvae of *Orthopodomyia signifera, Orthopodomyia alba, Aedes triseriatus,* and *Aedes zoosophus* (O. P. Wilkins unpublished). One of these larvae has been seen to remain beneath the water's surface very long, yet some of these can survive longer without access to atmospheric oxygen than *Aedes atropalpus*. Species of *Orthopodomyia* can survive from nineteen to thirty hours while those of *Aedes* have lived from sixteen to twenty-nine hours.

EGG DEPOSITION AND GENERAL EGG BIOLOGY

Several interesting observations in regard to egg deposition and the conditions under which eggs will hatch have been made by former writers. Dyar (1903) has pointed out that the eggs are laid in patches on the side of the rock hole, just above the surface of the water, usually at a time when the level of the water is low. Dyar assumes that the winter is passed in this state and that no adult hibernation takes place. He later notes that the first generation of the spring deposits its eggs on the surface of the water while only the fall generation deposits eggs in the manner previously observed. Observations of the writer confirm Dyar's thesis that the winter is passed in the egg stage and that no adult hibernation takes place. Dyar was not sure at this time how many generations per year this species had, so he assumed there were only two. This and other writers observed that the species is several brooded. It was also noted by the writer that any generation, except the last one of the fall, may deposit their eggs on the surface of the water. Eggs that Dyar obtained in October began to hatch in March and continued to hatch irregularly for some weeks. It is not clear, however, whether the eggs were sub-

merged in water from the time of collection until they began to hatch or whether they were placed in water just prior to hatching in March.

Trembley (1947) obtained eggs from laboratory-reared specimens and divided them into two groups. One group of eggs was immediately immersed in water and it was found that the time of hatching varied from twenty-four hours to twenty-four days. The other group of eggs, dried for two days and immediately immersed in water, yielded larvae in about equal numbers as the other group. Trembley also noted that laboratory-reared specimens deposited eggs single on the surface of the water or on damp filter paper.

It was with great difficulty that this writer induced females to oviposit in the laboratory. This was probably due to the fact that laboratory facilities for maintaining a constant temperature were not available at the time. However, on one occasion a large number of eggs were obtained. The adults from which these eggs were secured were collected as larvae on October 3, 1948, and began emerging as adults on October 6, 1948. From October 9-14, a total of five females accepted a blood meal from the arm of the writer. A finger bowl containing moist gravel was provided in anticipation of egg deposition. On October 16, the gravel in the finger bowl was noticed to be completely dry so the bowl was filled with water. The next day eggs were observed to be floated singly on the surface of the water and it seems quite probable that they were deposited there.

The eggs that had been deposited were left in water for approximately thirty-six hours. At the end of this time they were still floating on the surface and none of them had hatched. The eggs were removed to toweling paper where a count revealed that more than one hundred had been laid. The eggs were dried for forty-eight hours and as the prime objective at this time was to obtain first and second instar larvae no controlled experiments with the eggs were undertaken. However, certain observations relative to the hatching of this batch of eggs are of interest.

The eggs continued to hatch for twenty-four hours and as the larvae appeared they were removed from the container. The nonhatched eggs were left in water for another twelve hours but no eggs hatched during this time. Consequently, the water was removed and the remaining eggs were allowed to begin drying again. As a result of the first flooding approximately seventy-five of the original eggs hatched into first instar larvae. As some of the eggs remained unhatched at this time, they were reflooded at the end of another forty--eight hour of dissication. Ten first instar larvae were obtained as a result of the second flooding, the first larvae appearing fifty-eight minutes after the water was introduced.

In the weeks that followed, this same process was performed seven additional times, except that in some cases the eggs were dried for several days. The data and the results of this work are summarized in Table I. In the first series of floodings the last larva was obtained on November 29, (see table). After this date, the eggs were dried and flooded three additional times, but no larvae were obtained. On December 29, the eggs were left in water for one week, but again no eggs hatched.

At this time the writer dissected one of the unhatched eggs to determine whether it was still viable. A well developed, living embryo was observed to be present within the egg. The embryo was then removed to a container in an

attempt to rear it, but it was probably not sufficiently developed to live outside the egg for it died within an hour's time.

As it was definitely determined by the dissection that at least some of the eggs were still viable a method was sought to induce them to hatch. Prior to this time the eggs were kept in the laboratory under a rather warm temperature, and it was decided to subject them to a colder temperature. They were then placed outside the laboratory for forty-eight hours. During this period, the outside temperature dropped to twenty-eight degrees each night and remained below freezing for several hours. After the period of exposure to cold the eggs were brought back into the laboratory and immediately immersed. As a result of this flooding two larvae were obtained in about twelve hours. Two additional floodings were made without exposure to cold temperatures and a single larva resulted each time. At this time it was apparent that no viable eggs remained so the experiment was discontinued.

It is not possible to interpret these data accurately without additional controlled experiments. As indicated previously, only a relatively few eggs were obtained, and since the prime objective was to obtain as many young instar larvae as possible, controlled experiments with the eggs were not

TABLE I
RECORD OF EGG HATCHING

Date of Flooding	No. Larvae Hatched	Remarks
(1) 10/20/48	74	1st larva observed 1 hr 20 min
(2) 10/24/48	10	1st larva observed 1 hr
(3) 10/26/48	6	1st larva observed 38 min
(4) 10/30/48	11	1st larva observed 50 min
(5) 11/ 5/48	5	1st larva observed 35 min
(6) 11/13/48	4	1st larva observed 20 min
(7) 11/19/48	2	
(8) 11/29/48	1	
(9) 12/ 5/48	0	
(10) 12/ 8/48	0	
(11) 12/29/48	0	
The remaining eggs were at this time subjected to a minimum temperature of from 28-30 degrees F. for two days.		
(12) 1/22/49	1	
(13) 1/25/49	1	
(14) 2/ 4/49	1	
(15) 2/ 8/49	0	No viable eggs remained at this time.

feasible. However, if the usual batch of eggs deposited in nature shows similar reactions, the advantages to the species are obvious. The irregular hatching pattern would greatly increase the chances of survival of at least some larvae, even though the eggs were flooded several times with water that dried up before the larvae become mature.

If some of the eggs in nature require exposure to cold before hatching, this fact would prevent some of the eggs in the late fall from hatching, even if they should become covered with water. Thus even though some of the eggs in the late fall were to hatch and the resulting larvae were to be killed by cold weather, other eggs would survive the winter and not hatch until the water became warm in the spring.

SUMMARY

1. The biology of the white-banded rock hole mosquito, *Aedes atropalpus*, is discussed.

2. Particular attention was paid to the following points in regard to the general biology of this species: distribution and associated species, breeding sites including place of egg deposition, food of larvae, reaction of larvae of various instars when denied access to atmospheric oxygen, reaction of the larvae to light, general egg biology, and effect of temperature on the hatching of the eggs.

As far as can be determined, *Aedes atropalpus* has never been reported to occur in any other place besides rock holes. The writer and his associates have

TABLE II
LENGTH OF LIFE FROM EGG TO ADULT

Egg Hatched	Second Instar	Third Instar	Fourth Instar	Pupated	Adult
10/20/48	10/22/48 10:15 A.M.*	10/22/48 7:45 PM*	10/23/48 9:00 PM*	10/27/48	10/29/48
10/20/48	10/22/48 10:15 A.M.*	10/22/48 7:45 PM*	10/23/48 9:00 PM*	10/27/48	10/30/48
10/20/48	10/22/48 10:15 A.M.*	10/22/48 7:45 PM*	10/23/48 9:00 PM*	10/27/48 10:05 AM*	Died as Pupa
10/20/48	10/22/48 10:15 A.M.*	10/22/48 1:10 PM*	10/23/48 9:00 PM*	10/26/48	10/28/48
10/23/48	10/23/48	10/25/48	10/26/48	10/28/48	10/30/48
10/23/48	10/23/48	10/25/48	10/26/48	10/30/48	10/30/48
10/23/48	10/23/48	10/25/48	10/26/48	10/28/48	11/ 1/48
10/28/48	10/29/48	10/30/48	10/31/48	11/ 3/48	11/ 4/48
10/28/48	10/29/48	10/30/48	11/ 1/48	11/ 5/48	11/ 6/48

*Indicates time first observed

taken this species from tree holes on two occasions and from an artificial container once.

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A NOTE ON A SATURNIID MOTH FROM ARGENTINA (Lepidoptera)[1]

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Through the courtesy of Dr. Ricardo N. Orfila of Buenos Aires, I have received a copy of a recent paper (Orfila, 1951) in which he described a new genus and species of saturniid moth. It was unfortunately impossible to include reference to his name in the recently published generic revision of Western Hemisphere Saturniidae (Michener, 1952). However, from Orfila's excellent description it is easy to place his species in my classification; it should be called *Dirphia (Namuncuraia) mansosotoi* (Orfila), new combination.

The subgenus *Namuncuraia* Orfila is closest to *Ithomisa* from which it differs principally in the presence of an apical spine on each posterior as well as each anterior tibia. The decision as to whether this and other minor differences between *Ithomisa* and *Namuncuraia* are of subgeneric importance or are merely specific characters must await discovery of more species, if such exist.

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[1] Contribution No. 809, Department of Entomology, University of Kansas.

OBSERVATIONS ON THE INSECT FAUNA OF BIRDS' NESTS

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In spring of 1949 the writer became interested in the insect fauna of birds' nests. As a result, 27 nests were examined during spring and summer of 1949, and 20 during spring and summer of 1950. Most of the nests (41) were taken in or near Ames, Iowa. Three nests were taken from Ledges State Park, Iowa, and 3 were taken from Dewey's Pasture, Ruthven, Iowa.

The nests were taken as soon as possible after they had been abandoned by the young birds. However, in some instances the nests were in a rather dilapidated condition indicating that they had beeen abandoned for some time. Identification of nests was made for the most part by identifying the bird using it. Those nests discovered in a state of disuse were identified by structure and location. The work of Headstrom (1949) was valuable in identifying this type of nest.

Each nest with its accompanying debris was placed within a Berlese apparatus and left there for a period varying from 4 to 15 hours depending upon the bulkiness of the nest and the nature of the materials comprising it. Most of the nests were rather bulky or were composed of some specific insulating material such as mud or feathers. Consequently, they were pulled or broken apart to allow heat to pass throughout them more quickly.

Insects of sufficient size were mounted in the usual manner on points or pins. Smaller specimens were mounted in poly-vinyl-alcohol on microscope slides.

In all, 47 nests were examined of which 12 contained no insects. The 35 nests containing insects represented 15 different species of birds. A tabulation of the combined insect fauna according to nest type is presented in the following list. The number of nests of each species of bird is given in parentheses following the scientific name of the bird. Dates represent times at which nests were taken. Following the identity of each insect is listed the total number of individuals occurring in the nest or nests of that species of bird. In those instances where more than one nest of a single species of bird were examined, the number of nests in which the respective species of insects occurred is indicated in parentheses. In this and in a subsequent list all insect identities are given as specifically as possible. Where identities are uncertain, indication is made according to procedures stated by Schenk and McMasters (1936).

1. Black tern [*Chlidonias nigra surinamensis* (Gmelin)] (1)
—June 16, 1949, Dewey's Pasture, Ruthven, Iowa.
Enochrus (Methydrus) sp., 1 ad.
Enochrus sp., 2 ad.
Eulalia virgo (Wiedemann), 2 ad.
2. Yellow-billed cuckoo [*Coccyzus americanus americanus* (Linne)]
(1) — July 7, 1950, Ames, Iowa.
Liposcelis sp., many ad.
Leptothrips mali (Fitch), 1 ad.
Leptothrips (?) sp., 1 nymph.

Orthoperidae, 1 ad.
Mesogramma marginata (Say), 1 ad.

3. Eastern phoebe [*Sayornis phoebe* (Latham)] (3) — May 29, 1949, Ledges State Park, Iowa (2); July 29, 1950, Ledges State Park, Iowa (1).
Lepidocyrtus cyaneus Tullberg, 2 ad., (1).
Liposcelis sp., many ad., (3).
Hoplothripini, 1 nymph.
Atheta sp., 4 ad., (1).
Ataenius abditus (Hald.), 1 ad., (1).
Diapriidae, 1 ad., (1).
Syrphidae, 1 ad., (1).

4. Northern blue jay [*Cyanocitta cristata cristata* (Linne)] (1) — July 11, 1950, Ames, Iowa.
Liposcelis sp., many ad.
Atheta (?) sp., 2 ad.
Mesogramma marginata (Say), 1 ad.
Hippelates particeps (Beck.), 1 ad.

5. House wren (*Troglodytes aedon* subsp.) (2)—July 5, 1950, Ames, Iowa (1); July 8, 1950, Ames, Iowa (1).
Entomobrya sp., 1 ad., (1).
Sira buski Lubbock, 2 ad., (1).
Liposcelis sp., many ad., (1).

6. Prairie marsh wren [*Telmatodytes palustris dissaeptus* (Bangs)] (1) — June 16, 1949, Dewey's Pasture, Ruthven, Iowa.
Liposcelis sp., many ad.

7. Catbird [*Dumetella carolinensis* (Linne)] (2) — June 22, 1950, Ames, Iowa (1); August 3, 1950, Ames, Iowa (1).
Sira platani (Nicolet), 5 ad., (2).
Liposcelis sp., 1 ad., (1).
Terebrantia, 1 nymph, (1).
Lyctocoris campestris Fab., 1 nymph, (1).

8. Brown thrasher [*Toxostoma rufum* (Linne)] (4) — June 11, 1949, Ames, Iowa (2); July 8, 1949, Ames, Iowa (1); June 23, 1950, Ames, Iowa (1).
Xenylla (?) sp., 2 ad., (1).
Achorutes sp., 2 ad., (1).
Liposcelis sp., many ad. (only 1 specimen in 1 nest), (3).
Tapinoma sessile (Say), 11 workers and 1 female, (2).
Lycoriidae, 3 ad., (1).
Helomyzidae, 1 ad., (1).

9. Eastern robin (*Turdus migratorius migratorius* Linne) (9) — May 27, 1949, Ames, Iowa (1); May 28, 1949, Ames, Iowa (1); July 8, 1949, Ames, Iowa (2); June 5, 1950, Ames, Iowa (1); June 23, 1950, Ames, Iowa (2); July 7, 1950, Ames, Iowa (1); July 24, 1950, Ames, Iowa (1).
Entomobrya assuta Folsom, 7 ad., (2).
Sira buski Lubbock, 1 juv. and 1 ad., (1).
Sira platani (Nicolet), 2 ad., (2).
Liposcelis sp. (?), many ad., (7).
Lepinotus reticulatus Enderlein, 1 ad., (1).
Aeolothrips sp., 1 ad. female, (1).
Frankliniella tritici (Fitch), 1 ad., (1).
Karnyothrips americanus Hood, 1 ad., (1).
Terebrantia, 1 nymph, (1).
Piesma cinerea Say, 4 ad., (1).
Asthenidea temnostethoides Reuter, 1 ad., (1).
Atheta (?) sp., 3 ad., (2).
Oxytelus sp., 2 ad., (1).
Sacium sp., 4 ad., (1).
Melanophthalma (Corticarina) americana (Mannh.), 1 ad., (1).
Hypera nigirostris (F.), 4 ad., (1).

Chalcidoidea, 1 ad., (1).
Tapinoma sessile (Say), 2 ad., (1).
Helomyzidae, 1 ad., (1).
Madiza parva (Ad.), 1 ad., (1).

10. English sparrow [*Passer domesticus domesticus* (Linne)] (5) — May 28, 1949, Ames, Iowa (1); June 3, 1949, Ames, Iowa (1); July 8, 1949, Ames, Iowa (2); August 19, 1949, Ames, Iowa (1).
Liposcelis sp. (?), many ad., (4).
Trogoderma nigrescans Casey, many larvae plus 13 ad., (4).
Mesogramma marginata (Say), 1 ad., (1).
11. Red-winged blackbird (*Agelaius phoeniceus* subsp.) (1) — June 16, 1949, Dewey's Pasture, Ruthven, Iowa.
Sira platani (Nicolet), 1 ad.
12. Bronzed grackle (*Quiscalus quiscula aeneus* Ridgway) (1) — July 24, 1950, Ames, Iowa.
Sira platani (Nicolet), 1 ad.
Liposcelis sp., many adults.
Embidopsocus sp., many adults.
Karnyothrips americanus Hood, 1 ad.
13. Eastern cardinal [*Richmondena cardinalis cardinalis* (Linne)] (2) — May 28, 1949, Ames, Iowa, (1); June 22, 1950, Ames, Iowa (1).
Entomobrya assuta Folsom, 1 ad., (1).
Orthoperidae, 1 ad., (1).
Tapinoma sessile (Say), 1 worker, (1).
14. Rose-breasted grosbeak [*Hedymeles ludovicianus* (Linne)] (1) — June 11, 1949, Ames, Iowa.
Liposcelis sp., many ad.
Acholla multispinosa (De Geer), 1 1st or 2nd instar.
15. Eastern field sparrow [*Spizella pusilla pusilla* (Wilson)] (1) — June 22, 1950, Ames, Iowa.
Cryptophagidae, 1 ad.

For purposes of cross-reference the following tabulation is oriented toward insect species (or other classification categories where species could not be determined) rather than toward nest types. Accompanying each insect identity is the nest type or types from which the insect was taken. Numerals in parentheses represent the quantity of nests of that respective type in which the insect concerned was found.

Collembola
Entomobryidae
Entomobrya assuta Folsom—eastern cardinal (1); eastern robin (2).
Entomobrya sp.—house wren (1).
Lepidocyrtus cyaneus Tullberg—eastern phoebe (1).
Sira buski Lubbock—eastern robin (1); house wren (1).
Sira platani (Nicolet)—red-winged blackbird (1); catbird (2); eastern robin (2); bronzed grackle (1).
Poduridae
Achorutes sp.—brown thrasher (1).
Xenylla (?) sp.—brown thrasher (1).
Corrodentia
Liposcelidae
Liposcelis sp. (?)—eastern robin (7); eastern phoebe (3); brown thrasher (3); rose-breasted grosbeak (1); English sparrow (4); prairie marsh wren (1); house wren (1); yellow-billed cuckoo (1); northern blue jay (1); bronzed grackle (1); catbird (1).
Embidopsocus sp.—bronzed grackle (1).
Atropidae
Lepinotus reticulatus Enderlein—eastern robin (1).

Thysanoptera
- Aeolothripidae
  - *Aeolothrips* sp.—eastern robin (1).
- Thripidae
  - *Frankliniella tritici* (Fitch)—eastern robin (1).
- Phloeothripidae
  - *Leptothrips mali* (Fitch)—yellow-billed cuckoo (1).
  - *Leptothrips* (?) sp.—yellow-billed cuckoo (1).
  - *Karnyothrips americanus* Hood—eastern robin (1); bronzed grackle (1)
  - Hoplothripini (tribe)—eastern phoebe (1).
- Terebrantia (suborder)—eastern robin (1); catbird (1).

Hemiptera
- Piesmidae
  - *Piesma cinerea* Say—eastern robin (1).
- Reduviidae
  - *Acholla multispinosa* (De Geer)—rose-breasted grosbeak (1).
- Anthocoridae
  - *Asthenidea temnostethoides* Reuter—eastern robin (1).
  - *Lyctocoris campestris* Fab.—catbird (1).

Coleoptera
- Hydrophilidae
  - *Enochrus (Methydrus)* sp.—black tern (1).
  - *Enochrus* sp.—black tern (1).
- Orthoperidae—eastern cardinal (1); yellow-billed cuckoo (1).
- Staphylinidae
  - *Atheta* sp.—eastern phoebe (1).
  - *Atheta* (?) sp.—eastern robin (2); northern blue jay (1).
  - *Oxytelus* sp.—eastern robin (1).
- Dermestidae
  - *Trogoderma nigrescans* Casey—English sparrow (4).
- Cryptophagidae—eastern field sparrow (1).
- Phalacridae
  - *Sacium* sp.—eastern robin (1).
- Lathridiidae
  - *Melanophthalma (Corticarina) americanus* (Mannh.)—eastern robin (1).
- Scarabaeidae
  - *Ataenius abditus* (Hald.)—eastern phoebe (1).
- Curculionidae
  - *Hypera nigirostris* (F.)—eastern robin (1).

Hymenoptera
- Chalcidoidea—eastern robin (1).
- Diapriidae—eastern phoebe (1).
- Formicidae
  - *Tapinoma sessile* (Say)—eastern cardinal (1); eastern robin (1); brown thrasher (2).

Diptera
- Lycoriidae—brown thrasher (1).
- Stratiomyiidae
  - *Eulalia virgo* (Wiedemann)—black tern (1).
- Syrphidae
  - *Mesogramma marginata* (Say)—English sparrow (1); yellow-billed cuckoo (1); northern blue jay (1).
  - Undetermined syrphid—eastern phoebe (1).
- Helomyzidae—brown thrasher (1); eastern robin (1).
- Chloropidae
  - *Hippelates particeps* (Beck.)—northern blue jay (1).
  - *Madiza parva* (Ad.)—eastern robin (1).

An exact appraisal of frequency in which insects occurred in the various nests cannot be made from the foregoing tabulation because some nests contained more than one species of insect; hence, the same nest may be listed several times. To provide additional information on this subject a frequency summary may be helpful.

Corrodentia occurred in the largest number of nests (24 of a total of 35), and they occurred in nests representing the greatest variety of bird species (11 of a total of 15). Coleoptera were second in frequency of occurrence with specimens present in 15 different nests representative of 8 species of birds. Collembola were taken from 12 nests which represented 8 different species. Diptera occurred in 8 different nests distributed among 7 species. Thrips were present in 7 nests distributed among 5 species of birds. Hymenoptera were present in 6 different nests which represented 4 species, and hemiptera occurred in 3 nests which represented 2 species.

The insects occurring most frequently were corrodentia in the genus *Liposcelis*. These were present in 24 nests which represented 11 different species of birds. The collembolan, *Sira platani* (Nicolet), was present in 6 nests representing 4 species, and dermestids of the genus *Trogoderma* occurred in 4 nests, all of English sparrow. Ants of the species *Tapinoma sessile* (Say) were present in 4 nests which represented 3 species of birds. The remaining insects occurred less frequently, most of them being present in only one nest.

It is interesting to know what information others have obtained from observations of this type. Even though attempts were made to search comprehensively all available references, only the more thorough contributions are included.

The most detailed and comprehensive work on the insect fauna of birds' nests was done by Nordberg (1936). His observations were based upon the contents of 422 nests representing 56 species of birds. Of the total of 239 species of insects taken, *Ceratophyllus gallinae* Schr. (Pulicidae) occurred in nests representative of 45 species of birds. This was the most widely distributed species. Other insects which were present in a wide variety of nests were *Xenylla maritima* Tullb. (Poduridae), *Entomobrya marginata* Tullb. and *E. nivalis* L. (Entomobryidae), *Atheta nigricornis* Thoms. and *Microglossa pulla* Gyll. (Staphylinidae), and *Gnathoncus rotundatus* Illig. (Histeridae). *Liposcelis* is of relatively minor importance in his findings, for his list contains only two species, both of which are characterized by definitely restricted occurrence as far as variety of nests is concerned. Only one species of *Sira* is listed. It is even more restricted in distribution than the two species of *Liposcelis*, inasmuch as it was taken from nests representative of only 2 species of birds.

Leleup (1947) listed insects found in birds' and mammals' nests which he classified in accordance with particular ecological characteristics. He included a summary of frequency of occurrence of coleoptera as well as information pertaining to collembola, diptera, siphonaptera, hymenoptera and lepidoptera.

There are other references considerably less detailed in scope as compared with those just discussed. Dobroscky (1925) presented information on collembola, corrodentia, thysanoptera, hemiptera, homoptera, lepidoptera, diptera, coleoptera, and hymenoptera. Douglas (1871) contributed to the knowledge

of diptera, coleoptera, hemiptera and siphonaptera. Woodroffe and Southgate (1950) presented information pertaining to thysanura, collembola, corrodentia, hemiptera, lepidoptera, coleoptera, hymenoptera, diptera and siphonaptera.

Heselhaus (1915) listed 261 species of coleoptera of which approximately one-third were taken from birds' nests and the remainder from nests of mammals. Representatives of the genera *Atheta, Microglossa* and *Oxytelus* were among the most frequent. Hymenoptera and siphonaptera were also listed. Of the latter, *Ceratophyllus gallinae* (Schrank) occurred in a wider variety of nests than did any other species of flea.

In his comprehensive treatment of blowflies Hall (1948) included a list of 54 species of birds reported to be hosts of various species of *Apaulina.* The birds were parasitized by the larvae which were taken chiefly from fledglings and from nesting materials.

References to the work of Donisthorpe (1931a, 1931b) represent only a small part of the extensive study he made on this subject. He was interested primarily in coleoptera, although he did record a few generalized lists of insect fauna. Another worker who made extensive observations on coleopterous fauna was Joy (1906a, 1906b, 1930). He was especially interested in staphylinids. Palm (1936) contributed information on the coleoptera occurring in nests of rapacious birds. Extensive observations were made by Thompson (1937a, 1937b) on fleas occurring in birds' nests. Waterston (1906, 1909, 1910) was another worker in the study of fleas. An additional reference, includes Agrell (1945) on collembola.

Several investigators specialized somewhat on the nest faunas of specific birds or bird groups. Studies were made by Jellison and Philip (1933) on nests of magpie *(Pica p. hudsonicus)* and crow *(Corvus brachyrhynchos).* Nests of the bank swallow *(Riparia riparia)* were studied by Snyder and Shannon (1919). Interesting investigations of the nests of other birds include observations on bluebirds' nests by Johnson (1927), and the work of Dorn (1913) in presenting information on nests of several raptorial birds, chiefly sparrow hawk *(Accipiter nisus);* however, studies of owls, ravens *(Corvus corone),* the young of *Astur palumbarius,* meadow hawk *(Circus macrurus),* and wood owl *(Asio otus)* were included.

Of the insects included on the preceding list pertaining to insect species in birds' nests, the following have not been found by the writer in studies of the literature which was available: *Sira platani* (Nicolet), *Achorutes* sp., *Embidopsocus* sp., *Lepinotus reticulatus* Enderlein, *Aeolothrips* sp., *Frankliniella tritici* (Fitch), *Leptothrips mali* (Fitch), *Karnyothrips americanus* Hood, *Piesma cinerea* Say, *Acholla multispinosa* (De Geer), *Asthenidea temnostethoides* Reuter, *Enochrus* sp., *Trogoderma nigrescans* Casey, *Melanophthalma (Corticarina) americana* (Mannh.), *Ataenius abditus* (Hald.), *Hypera nigirostris* (F.), *Eulalia virgo* (Weidemann), *Mesogramma marginata* (Say), *Hippelates particeps* (Beck.), and *Madiza parva* (Ad.).

However, among the insects just listed, there are four genera which are present in the literature of birds' nests fauna, but each of the four lacks any species designation. These four genera are *Sira, Trogoderma, Melanophthalma,* and *Hypera.*

Most of the insect specimens collected in this study have been deposited in the Iowa State College collection. Exceptions are *Aeolothrips* sp., *Acholla multispinosa* (De Geer), *Asthenidea temnostethoides* Reuter, *Lyctocoris campestris* Fab., *Melanophthalma (Corticarina) americanus* (Mannh.), *Tapinoma sessile* (Say), and the chalcid. Some of these specimens were retained by the specialists who examined them. Others were lost in transit.

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THE LANGURIIDAE AND EROTYLIDAE (Coleoptera) OF MISSOURI WITH NOTES AND KEYS

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This is the first of a series of studies on the Coleoptera of Missouri that the authors hope to present as contributions toward a catalogue of the insects of Missouri.

As a search of the literature will reveal, the insect fauna of Missouri is rather poorly known. Many of the local records that do appear are scattered and frequently very old and unreliable — such as those of Thomas Say which were made at a time when the term "Missouri" covered an area much more extensive than that now included within the state's borders. Many of these records need verification while the large number of unrecorded species should be listed. In the two families treated here, for instance, of the twenty-five species reported for the state only eleven had been previously listed.

These two families are here treated together first as a matter of convenience and secondly because they were formerly considered to be but subfamilies of one family, the Erotylidae. Recent workers have not only emphasized their distinctness but have indicated that the affinities of Languriidae lie closer to Cryptophagidae than to Erotylidae.

The authors are especially grateful to Dr. C. W. Wingo, University of Missouri, for comparing specimens of *Triplax frontalis* Horn and *T. macra* Leconte with their respective types during his tour of some of the eastern museums; and to Mr. R. I. Wakeman, of Kansas City, Missouri, who presented his modest private collection of Coleoptera for incorporation with the Froeschner collection — the Wakeman collection has been especially helpful to Missouri studies because it contained many specimen-records for the poorly

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collected northwestern part of the state. Access to the University of Missouri collection was made possible through the usual kind helpfulness of Dr. L. Haseman, head of the Department of Entomology in that institution; and to the Craig collection through the generous cooperation of Mr. W. S. Craig.

The records not directly attributable to either author are indicated by the initials of their collectors, as in the following list: C. W. Wingo, E. H. Froeschner, G. Henderson, H. I. Rainwater, H. L. Koch, R. I. Wakeman, W. S. Craig, W. W. Groth and W. W. Smith.

The illustrations are originals by Elsie Herbold Froeschner.

LANGURIIDAE OF MISSOURI

Keys to the Missouri Genera and Species

1. Vertex with a distinct, longitudinal stria laterally near the inner margin of each eye and extending full length of the eye ..... *I. Languria*
   Vertex without such striae ..... II. *Acropteroxys*

I. *Languria* Latreille

1. Antennal club 6-segmented: head, meso- and metathorax and abdomen, except last segment, red; length 7-13. (Fig 1) ..... 1. *bicolor* (Fab.)
   Antennal club 5-segmented 2
2. (1) Head and pronotum red to yellow, latter not marked discally with black 3
   Head black 4
3. (2) Antennal club abrupt, segment VII at least twice as wide as VI; abdomen and legs piceous; length 8-11 mm. .... 2. *laeta* LeC.
   Antennal club gradually formed, VII less than twice as wide as VI; femora on basal half and basal half or more of abdomen red; length 4-9 mm. ..... 3. *mozardi mozardi Latr.*
4. (2) Legs wholly red; elytra with a broad red band medially; length 5-9.5 mm. ..... 4. *trifasciata* Say
   Apices of femora black; elytra banded or not; length 6-9 mm. ..... 5. *angustata* (Beauv.)

II. *Acropteroxys* Gorham

1. Discal black spot of pronotum round or oval, not reaching base or apex; elytra with coarse, deep punctures between striae; length 9-12 mm. ..... 6. *lecontei* (Crotch)
   Discal black spot of pronotum extending from base to apex of pronotum; elytra with small, shallow punctures between striae; length 6-12 mm. ..... 7. *gracilis* (Newm.)

Notes on the Languriidae of Missouri

1. ***Languria bicolor*** (Fab.). Field collected specimens were taken from a variety of weeds in or near woods between May 14 and June 15 and once again on August 16. Bollinger (EHF), Boone (WSC), Gasconade (EHF), Pike (WSC) and St. Louis counties.

2. *Languria laeta* LeC. It is rather interesting to note that one of the two species reported for Missouri in Vaurie's (1948) recent treatment of the family is this one for which we have no local specimens. That record is the sole authority for including this species in our state list.

3. *Languria mozardi mozardi* Latr. In describing a new western subspecies of *mozardi* Vaurie (1950) indicated that the eastern form should be known as the nominal one and will take the above trinomial designation. The larva is the "clover-stem borer" which does considerable damage to clover by boring in the stalk of the plants. It is quite common in Missouri, adults being seen frequently on the flowers and branches of various clovers. The seasonal data at hand indicate adults as occurring from January through August, but further collecting should find them throughout the year. They hibernate chiefly in grass clumps but are occasionally found under rocks, logs and other debris on the ground. Rau (1926) listed it as a "visitor" to his "sheltered clay bank" in Jefferson County. The following list of counties indicates a general distribution within the state: Adair, Barton, Bollinger (EHF), Boone, Buchanan, Camden, Cape Girardeau, Cass, Cole, Dade, Douglas (EHF), Dunklin, Greene (HIR), Harrison, Holt, Iron (EHF), Jasper, Jefferson (EHF), Lawrence (WWS), Lewis, Mississippi, Moniteau, Newton, Pemiscot, Pettis, Phelps, Platte, Pike, St. Charles, St. Louis, Schuyler, Stoddard, Stone (EHF) and Worth (RIW).

4. *Languria trifasciata* Say. Adults of this uncommon species have been collected from September 18 to May 26. It hibernates under debris and in clumps of *Andropogon*. Vaurie (1948) reported five specimens for the state. Boone, Cass (WWG), Cole, Franklin (EHF), Harrison (EHF), McDonald, Mississippi, Pike (WSC), St. Charles and St. Louis counties.

5. *Languria angustata* (Beauv.). This species was listed for the state by Crotch (1873) and Leng (1920), the latter giving the "Mo." record behind the form *uhleri* Horn which Vaurie (1948) considered as simply a color variation of *angustata* and so synonymized it. We have collected adults during May, August and November, the latter in grass clumps and under logs apparently in hibernation. Butler, Iron, Mississippi and Ste. Genevieve counties.

6. *Acropteroxys lecontei* (Cr.). A single specimen was found among some miscellaneous material collected from the Japanese beetle traps in St. Louis. No date was available.

7. *Acropteroxys gracilis* (Newm.). This species was swept frequently from many different weeds, especially those along stream banks. Adult records at hand extend from May 29 through August 6. Barry, Boone, Buchanan (RIW), Carter, Christian (CWW), Gasconade, Jasper, Lawrence, Newton, Nodaway, Phelps, Pike (WSC), St. Charles St. Louis, Saline, Schuyler and Taney counties.

EROTYLIDAE OF MISSOURI[3]

Keys to the Missouri Genera and Species

1. Tarsi distinctly 5-segmented, segments I-III not gradually wid-

[3] Mr. W. W. Boyle, of Cornell University at Ithaca, New York, has been preparing a revisionary study of the Erotylidae and has furnished me with data for a better separation of *Tritoma* and *Triplax* (which is incorporated in the corrected generic key presented here.)

ened: mentum strongly transverse 2
Tarsi apparently 4-segmented, the true fourth being very small and united to base of fifth, I-III widened outward; mentum triangular 4

2. (1). Tarsi narrow, not dilated; size small, not over 3.5 mm. ..... IV. *Dacne*
Tarsi dilated, spongy pubescent beneath; larger, 5 mm. or more 3

3. (2). Last segment of labial palpus hatchet-shaped; head and disc of pronotum polished, nearly smooth; larger, 9 mm. or more ..... V. *Megalodacne*
Last segment of labial palpus oval or cylindrical; head and pronotum coarsely punctuate; length not over 6 mm. ..... VI. Microsternum

4. (1). Antennal segment III elongate, as long as or longer than IV plus V; metasternum with a line running obliquely outward from inner angle of middle coxa 5
Antennal segment II short, not more than three-fourths as long as IV plus V; metasternum without such a line ..... III. *Triplax*

5. (4). Size larger, length 6.5 mm. or longer; terminal segment of maxillary palpus small, not longer than terminal antennal segment ..... I. *Ischyrus*
Size smaller, length not more than 5 mm.; terminal segment of maxillary palpus enlarged, distinctly longer than terminal antennal segment ..... II. *Tritoma*

I. *Ischyrus* Lacordaire

1. Above yellow with head, four spots across pronotum and three interrupted bands across elytra black; beneath black with sides of abdomen yellow; length 7-8 mm. ..... I. *quadripunctatus* (Oliv.)

II. *Tritoma* Fabricius[4]

1. Elytra not wholly black 2
Elytra wholly black 6

2. (1). Red of elytra limited to spots on basal third 3
Red of elytra much more extensive 4

3. (2). Underside piceous black, apex of last abdominal segment pale; length 3-4 mm. ..... 9. *humeralis* Fab.
Underside entirely pale; length 3-4 mm. ..... 7. *biguttata* Say

4. (2). Elytra and scutellum wholly red; length 4-4.5 mm. (Fig. 2) ..... 2. *sanguinipennis* (Say)
Elytra not wholly red 5

He has also called attention to the fact that by these characters species no. 4, *dissimulator* Cr., is not a *Tritoma* but a *Triplax*. *Triplax dissimulator* (Cr.) (NEW COMBINATION) differs from all the other species here listed in *Triplax* in having two black spots on the midline of the pronotum, one basal and one apical, while the others have the pronotum unicolorous pale.

[4] See footnote 3 on transfer of *dissimulator* from this genus to *Triplax*.

5. (4). Scutellum, legs and oblique apical third of elytra black; length 3.5 mm. ..... 3. *pulcher* (Say)
Scutellum, legs and all of elytra except margins behind humeri and at apex dull red; length 4-4.3 mm. .... 10. *mimetica* Cr.
6. (1). Head and entire dorsum piceous to black 7
Head reddish-yellow 8
7. (6). Underside piceous; legs and palpi brownish-yellow; length 3-4 mm. ..... 5. *angulata* Say
Underside black; tarsi and palpi piceous; length 4-5 mm. ..... 11. *unicolor* Say
8. (6). Head reddish-yellow, pronotum and elytra concolorous black; length 3.5-4 mm. ..... 8. *erythrocephala* Lac.
Head and pronotum both greatly or entirely reddish-yellow 9
9. (8). Pronotum with two black spots on midline, one basal and one apical; length 4.5 mm. ..... 4. *dissimulator* Cr.
Pronotum without dark spots; underside of body in large part black; length 2.8-3.4 mm. ..... 6. *atriventris* Lec.

III. *Triplax* Herbst[5]

1. Elytra with a broad undulating band of yellow-red across middles; length 5-6.3 mm. ..... 12. *festiva* Lac.
Elytra wholly black; head, at least in part, and pronotum red or yellow 2
2. (1). Body beneath reddish-yellow; antennae black or reddish only at base 3
Body beneath, except prosternum, black; antennae red, clubs only black; length 3-4 mm. ..... 13. *flavicollis* Lac.
3. (2). Larger, 6-6.5 mm.; head and basal segments of antennae reddish ..... 16. *macra* Lec.
Smaller, length not over 5 mm. 4

[5] See footnote 3 on transfer of *dissimulator* to this genus from *Tritoma*.

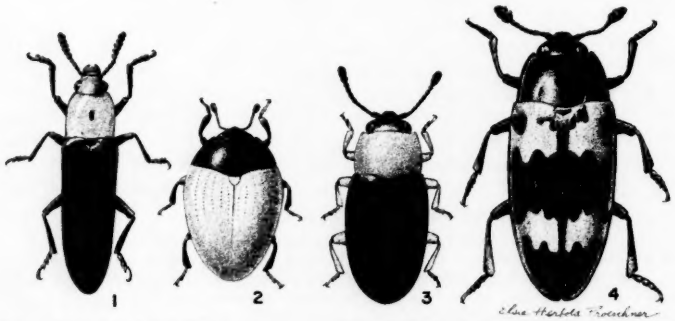

Fig. 1. Languria bicolor X3
Fig. 2. Tritoma sanguinipennis X5
Fig. 3. Triplax frontalis X5
Fig. 4. Megalodacne fasciata X3

4. (3). Head and basal half of antennae reddish; length 4-4.7 mm. ..... *thoracica* Say
Head, except vertex, and all of antennae black; length 3-4.7 mm. (Fig. 3)..... 15. *frontalis* Horn

IV. *Dacne* Latreille

1. Black, elytra each with a rounded, reddish-yellow spot on humerus and a more elongate one at apex; length 2.5-3 mm. ..... 17. *quadrimaculatus* (Say)

V. *Megalodacne* Crotch

1. Elytra with rows of fine punctures; length 9-15 mm. (Fig. 4) ..... 18. *fasciata* (Fab.)
Elytra without rows of punctures; length 18-21 mm. ..... 19. *heros* (Say)

VI. *Microsternum* Lewis

1. Head, pronotum and four distinct spots on each elytron black; length 5-5.5 mm. ..... 20. *ulkei* (Cr.)

Notes on the Erotylidae of Missouri

1. *Ischyrus quadripunctatus* (Oliv.). Adults have been found uncommonly under bark and on various fungi during every month of the year. The first state record for this was published under the generic name *Erotylus* by Say (1835); the subsequent listings by Leconte (1854), Crotch (1873) and Leng (1920) are made under the currently used name. Atchison, Bates (HIR), Bollinger, Boone (RIW), Buchanan, Caldwell, Dunklin, Holt, Pemiscot, Phelps, Pike (WSC), St. Louis, Saline (EHF), Shannon (EHF) and Vernon counties.

2. *Tritoma sanguinipennis* (Say). The only Missouri material studied was a single individual collected from under loose bark in Boone county on January 7.

3. *Tritoma pulcher* (Say). Our two specimens were taken from under bark in Dunklin and Maries counties on March 16 and June 17 respectively.

4. *Tritoma dissimulator* Cr. Originally described from Illinois this species might be found in Missouri.

5. *Tritoma angulata* Say. A single specimen in the Craig Collection had been taken on September 7 in Pike County (WSC).

6. *Tritoma atriventris* Lec. Crotch (1873) recorded this species from the state under the name *Cyrtotriplax;* while the later listings by Kuhnt (1909) and Leng (1920) were under the present name. Our material had been collected from fungus growth under bark and on logs from May through November, but adults probably will be found to occur throughout the year. Barry, Boone, Greene, Jefferson, Lafayette, McDonald, St. Charles (WSC), St. Louis and Taney (CWW) counties.

7. *Tritoma biguttata* Say. Mr. W. W. Boyle has furnished a "St Louis" record for this species.

8. *Tritoma erythrocephala* Lac. Crotch's (1873) Missouri record was made under the generic name *Cyrtotriplax;* it apparently was the basis for subsequent listings by Kuhnt (1909), Blatchley (1910) and Leng (1920) under the modern name. We have seen no local specimens.

9. *Tritoma humeralis* Fab. Apparently in Missouri this species occurs in three color forms which may be separated by the following key:

1. Head as well as pronotum black ..... *humeralis* (Fab.)
   Head reddish 2
2. Pronotum black ..... *ruficeps* Lec.
   Pronotum as well as head reddish ..... *aulica* Horn

These three forms are mentioned in literature as follows: In 1872 Horn described *Triplax (Tritoma) aulica* without giving a definite type locality but stated that it was described from specimens "collected and kindly presented by Dr. S. V. Summers, of St. Louis, Missouri." Later citations of this form were for Ohio. The following year Crotch (1873) reported the species for the state as a *Cyrtotriplax*. The other color form, *ruficeps* Leconte, was listed for the state by Kuhnt (1909) and Leng (1920). Except for one specimen of *aulica* taken in St. Charles County (WSC) on June 20, all specimens studied belonged to the nominal form and had been collected between September 16 and May 10. Harrison, Mississippi (WSC), Pemiscot, Pike (WSC), St. Charles (WSC) and Schuyler counties.

10. *Tritoma mimetica* Cr. Of the few specimens seen, one was labelled as having been taken from the mushroom, *Collybia radicata*. Collection dates were for the period between April 24 and June 22. Franklin and St. Louis counties.

11. *Tritoma unicolor* Say. Mr. W. W. Boyle has furnished a "St. Louis" record for this species.

12. *Triplax festiva* Lac. Mr. E. C. Becker collected a good series of this in Callaway County on April 20.

13. *Triplax flavicollis* Lac. Adults of this common species have been collected the year around from various species of fungus, including some *Pleurotus*. Rau (1922) apparently referred to this species when he gave the following observations under the name *"Tritoma planicollis* Lacordaire:" "Several of these beetles were feeding on a fungus on the sunny side of a tree and six or eight feet above the ground at Wickes, Mo., on June 11, 1917." Andrew (RIW), Bates, Boone, Butler, Caldwell, Dunklin, Jefferson, Oregon, Pike (WSC) and St. Louis counties.

14. *Triplax thoracica* (Say). During every month of the year adults of this species have been taken commonly from under bark and on fungi. Casey (1916) described three "subspecies", *antennata, obliqua* and *brevicollis*, from St. Louis and gave the range of nominal *thoracica* as "eastward of the Appalachians" but did list one specimen from Indiana. The original descriptions of those three subspecies yielded the characters for the following key:

1. Size small, length 2.9 mm.; head "nearly three-fourths as wide as thorax" ..... *brevicollis* Csy.
   Size larger, length 3.4 mm. or longer; head narrower, at most "much more than half as wide as the prothorax" 2
2. Antennae as long as head plus pronotum; antennal III "distinctly shorter as a rule than the next two combined; length 3.4-4.8 mm. ..... *antennata* Csy.
   Antennae much shorter than head plus prothorax; length 4.9 mm. ..... *obliqua* Csy.

Antennata was described as "Very abundant" while each of the other two was described from a single female. On the basis of the above, all of our material was of the subspecies *antennata*. All three of Casey's subspecies were listed for the state by Leng (1920). Bates, Boone, Caldwell, Cape Girardeau (CWW), Dunklin (EHF), McDonald, Oregon, Pemiscot, St. Louis and Wayne counties.

15. *Triplax frontalis* Horn. A modest series was collected under bark in Pike County on April 18. Several specimens of this series were compared with types in the Horn collection by Dr. C. W. Wingo.

16. *Triplax macra* Lec. Our four specimens were collected under bark in Boone County during January and May. Two of these were compared with the Leconte types by Dr. C. W. Wingo.

17. *Dacne quadrimaculata* (Say). A small series was collected from under bark in Callaway County on April 20 by Mr. E. C. Becker.

18. *Megalodacne fasciata* (Fab.). This common beetle has been found under bark and on fungi from October 20 to June 24. On September 14 several fully grown larvae were found in burrows in a shelf fungus, *Polyporus* sp. They were moved to the outside of a laboratory window where they pupated three days later. Adults emerged on October 25. Akerlind (1907) listed it from St. Louis. Boone, Carrolton (GH), Dunklin (EHF), Henry (GH), Howard (HLK), Mississippi, Pemiscot, Pulaski, St. Charles and St. Louis counties.

19. *Megalodacne heros* (Say). Two specimens were found in association with numerous *M. fasciatus* under loose bark in Dunklin County on May 12.

20. *Microsternum ulkei* (Cr.). The records for Indiana and Kentucky indicate that we might expect to find this species in Missouri.

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THE MEXICAN SPECIES OF ALLAPORUS (Hymenoptera: Pompilidae)

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The genus *Allaporus* includes some of the smallest of spider wasps, the size range within the genus being from about 2.5 to about 8.5 mm. The species appear to occur in a wide variety of habitats, and are only rarely attracted to flowers. Nothing is known of their biology, though the structure suggests that they may prey upon some type of subterranean spider. As might be expected from the foregoing, specimens are rare in collections. Three species are known from the United States, chiefly from the southern part; two of these have been known from only two specimens each. Only one specimen, the type of *mexicanus*, has been recorded from Mexico.

On a collecting trip to Mexico in the summer of 1951, Dr. Paul D. Hurd, Jr., and the writer[1] collected 18 specimens of *Allaporus* belonging to five species. This is a rich collection for a single trip, and suggests that the center of distribution of the genus may be in Mexico. All three of the species known from the United States appear to be widely distributed in Mexico, and two new species have been discovered. The collection is of unusual interest in that it contains males of four species. Previously only the male of *rufiventris* was known.

KEY TO SPECIES

1. First abscissa of radius of hind wing very short and nearly vertical; first abscissa of cubitus of hind wing short, forming nearly a straight line with the transverse cubital vein (Fig. 1) (*Rufiventris*-group) 2
   First abscissa of radius of hind wing longer and much more oblique; first abscissa of cubitus much longer, strongly arched before its junction with the transverse cubital vein (Fig. 2) (*Mexicanus*-group) 3
2. Female: wings not banded, merely somewhat infuscated toward the apex; abdomen not conspicuously banded; length 3 to 6 mm.; male: genitalia as in figure 7 ..... *rufiventris* (Cresson)
   Female: wings conspicuously twice-banded; abdomen with alternating bands of silvery and brownish pubescence; length 7 mm.; male: unknown ..... *elegantulus* new species
3. Female: unknown; male: body rendered a rich blue by the pubescence; scape, head, thorax, propodeum, and legs to the femora, conspicuously hairy ..... *toltecus* new species
   Female: head and thorax black, with extensive silvery pubescence; abdomen rufous; male: body not or scarcely bluish; less hairy, the scape, propodeum, and femora not at all hairy 4

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[1] This collecting trip was made possible to the writer by a grant-in-aid from the Penrose Fund of the American Philosophical Society.

4. Female: front femora slightly incrassate; posterior ocelli closer to the vertex crest than to one another; spatium frontale prominent, on a much higher plane than the clypeus; male: wings somewhat infuscated; subgenital plate rather broad, obtusely pointed apically (Fig. 10) ..... *mexicanus* Evans
Female: front femora very slender; posterior ocelli about as close to one another as to the vertex crest; front rather flat, the spatium frontale not prominent, on about the same plane as the clypeus; male: wings entirely hyaline; subgenital plate slender, the apex acuminate (Fig. 9) ..... *amabilis* Evans

Rufiventris Species-group

The two species *rufiventris* and *elegantulus* are structurally very similar. The venation of the hind wing (Fig. 1) is distinctive; in the fore wing the second submarginal cell is usually not much if any wider than high, and is sometimes triangular.

Allaporus rufiventris (Cresson)

Allaporus rufiventris (Cresson), 1872, Trans. Amer. Ent. Soc., 4: 207.—Bradley, 1944, Trans. Amer. Ent. Soc., 70: 120. (Synonymy and redescription).

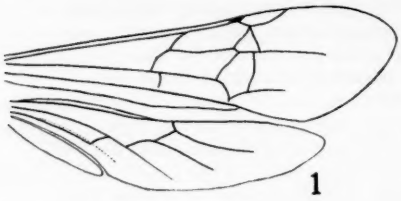
This species appears to be the most common and widely distributed member of the genus in Mexico, as it is in the United States. All Mexican females seen have the abdomen entirely rufous; the legs may be entirely black, or the middle and hind legs may be partly or wholly rufous. The male genitalia, shown in figure 7, exhibit some intraspecific variation but appear to differ from those of related species in the short parameres which are somewhat widened just below the apex; in side view the apex of the paramere is obliquely truncate. The subgenital plate is strongly keeled, not quite as broad as that of *mexicanus,* shown in figure 10.

Mexican records are as follows: HIDALGO: 5 ♀ ♀, 2 ♂ ♂, Zimapán, 11-14 June 1951, on *Condalia mexicana* Schl. (Evans); PUEBLA: 1 ♀, Tehuacán, 23 June 1951, on honeydew (Evans); MEXICO: 1 ♂, Teotihuacán Pyramids, 16 June 1951 (Evans); MICHOACAN: 1 ♂, 5 km. W. of Zacapu, on ground in open oak forest, 13 July 1951 (Evans); ZACATECAS: 2 ♀ ♀, 15 km. E. of Sombrerete, 28-31 July 1951 (Hurd).

Allaporus elegantulus new species

This is a showy species, with conspicuously banded body and wings. Structurally it is very similar to *rufiventris*. Only the female is known.

Female. Length of body 7 mm.; fore wing 4.5 mm. Color black, except the mandibles ferruginous; body entirely clothed with a rather coarse, appressed pubescence, for the most part conspicuously silvery, but duller and brownish on the antennae, upper front and vertex, mesonotum, scutellum, apices of the legs, broad preapical bands on abdominal tergites one through five, and all of the apical abdominal segment. Wings prominently banded, the fore wing subhyaline, with a dark band over the basal and transverse median veins, and a broader and darker band beginning at the marginal, second submarginal, and third discoidal cells and extending almost, but not quite, to the outer wing margin; hind wings hyaline, the apex clouded.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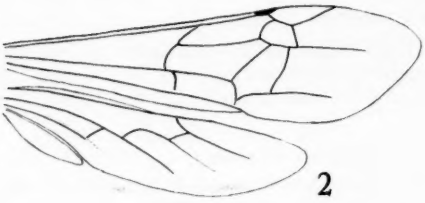
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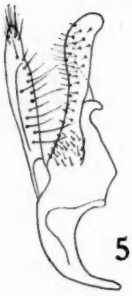
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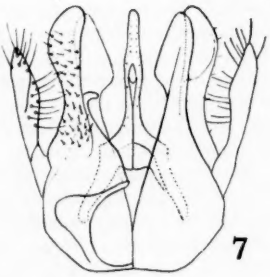
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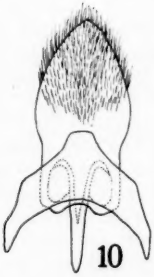
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Mandibles of normal configuration, with two weak teeth on the inner margin. Clypeus 2.8 times as broad as high, its apical margin broadly truncate. Face below and at the sides of the antennal sockets on the same plane as the clypeus; spatium frontale forming a prominence above and between the antennal sockets. Front very broad in relation to the eyes, the middle interocular distance .7 the transfacial distance; eyes converging very slightly on the vertex. Vertex not elevated above the eye-tops, the posterior ocelli closer to the vertex crest than to one another. Postocellar line: ocello-ocular line as 10:9. First four antennal segments in a ratio of about 12:5:11:12, segment three a little more than half as long as the upper interocular distance. (Side view of head: Fig. 3).

Propodeum rather long, without noticeable rugosities. Front femora very slightly swollen (about as in *rufiventris*), the maximum width about .3 the length. Legs moderately spinose, apically with somewhat coarse pubescence for the genus. Fore wing with the basal vein somewhat angulate mid-way between the media and the cubitus; second submarginal cell triangular, the first and second transverse cubital veins meeting the radius at the same point; hind wing with the radius short and nearly vertical before its junction with the transverse cubital vein, the cubitus short before its junction with the transverse cubital vein (Fig. 1). Abdomen cylindrical, the apex not noticeably compressed.

Holotype. ♀, El Salto, DURANGO, 3 August 1951; collected on the ground in an open pine-oak forest at about 8000 feet elevation (P. D. Hurd) [Univ. Calif.].

Mexicanus Species-group

This is structurally a more diverse group than the preceding, but its members are easily recognized by the wing venation, as described in the key and as illustrated for *toltecus* (Fig. 2). This venation is more like the "normal" type in the Aporini; the incrassate front femora of one species also suggest an affinity of this group with such genera as *Aporus* and *Euplaniceps*.

Allaporus mexicanus Evans

Allaporus mexicanus Evans, 1950, Ent. News, 61:3.

In the structure of the head, *mexicanus* is not dissimilar to the preceding two species, but the swollen front femora and different venation separate it readily from these species. The male has not previously been described, and for this reason a brief description is given of a single specimen which probably represents the male of this species.

EXPLANATION OF FIGURES

Figure 1: Wings of *Allaporus elegantulus* new species; Figure 2: Wings of *A. toltecus* new species; Figure 3: Side view of head of female *A. elegantulus* new species; Figure 4: Side view of head of female *A. amabilis* Evans; Figure 5: Ventral view of left paramere and volsella of *A. amabilis* Evans; Figure 6: Same of *A. mexicanus* Evans; Figure 7: Male genitalia of *A. rufiventris* (Cresson), ventral aspect on left side, dorsal on right; Figure 8: Ventral view of left paramere and volsella of *A. toltecus* new species; Figure 9: Subgenital plate of *A. amabilis* Evans; Figure 10: Subgenital plate of *A. mexicanus* Evans.

Male. Length 5 mm.; fore wing 5 mm. Color black; fore wings very lightly infuscated, a little darker beyond the stigma and third discoidal cell; hind wings subhyaline. Pubescence mostly dark, brownish or somewhat cinereous, obscurely violaceous. Scape not hairy; clypeus, front, vertex, temples, and propleura slightly hairy; body elsewhere with only very short, inconspicuous setae. Front moderately convex, rather broad, the inner orbits diverging very slightly above. Posterior ocelli very slightly closer to one another than to the nearest eye-margin, removed from the crest of the vertex, which is fairly sharp, by less than their own diameter. First four antennal segments in a ratio of about 17:8:9:14; segment three scarcely longer than wide. Longer spur of hind tibia about .9 the length of the basitarsus. Wing venation not differing notably from that figured for *toltecus;* second submarginal cell 1.6 times as broad as high. Subgenital plate (Fig. 10) rather broad. Genitalia very similar to those of *rufiventris;* the parameres appear to be slightly more elongate, and the setae on the digiti are decidedly longer and more bristling than in other known species (Fig. 6).

Distribution records: MORELOS: 1 ♀, Cuernavaca, May 1945 (N. L. H. Krauss); 1 ♀, Alpuyeca, 27 June 1951 (Evans); PUEBLA: 1 ♂, 14 mi. W. of Huauchinango, 17 June 1951 (Evans); TEXAS: 1 ♀, Brownsville, 8 June 1937 (R. H. Crandall).

Allaporus amabilis Evans

Allaporus amabilis Evans, 1950, Ent. News, 61: 2.

Previously known from one locality in California, this species can now be recorded from Texas and from two states of Mexico. The female differs markedly from related species in the form of the clypeus and mandibles; the spatium frontale is not at all prominent as in other known females of this genus (Fig. 4); the apex of the abdomen is somewhat compressed; the front femora are more slender than in any other species of the genus. The male is here described for the first time. I feel certain that this association of the sexes is correct, since the male shows some of the modification of the mandibles of the female, and the vertex is somewhat elevated behind the ocelli.

Male. Length 5 mm.; fore wing 4 mm. Color black; wings clear hyaline, only the veins brownish. Pubescence in large part silvery, coarse and conspicuous on the posterior slope of the propodeum, somewhat brownish on the vertex, mesonotum, apex of the abdomen, and the legs. Body with a very few inconspicuous setae on the vertex, elsewhere virtually without erect hairs. Mandibles rather broad, somewhat twisted about mid-way, the apical half shining. Front broad, moderately convex, the inner orbits diverging somewhat above. Posterior ocelli removed from the vertex crest by more than their diameters. Vertex raised in the ocellar triangle; crest rather sharp. First four antennal segments in a ratio of about 16:8:9:11, segment three thus much shorter than the rather slender scape, and only very slightly longer than thick. Longer spur of hind tibia as long as the basitarsus. Venation not differing notably from other members of the species-group; second submarginal cell 1.5 times as broad as high. Subgenital plate rather slender, its apex acute (Fig. 9). Genitalia with the parameres nearly as long as the digiti; setae on

the digiti fairly prominent but not as long and bristling as in the preceding species (Fig. 5).

Distribution records: ZACATECAS: 1 ♂, 15 km. E. of Sombrerete, 28-31 July 1951 (Hurd); DURANGO: 1 ♀, 8 mi. S. of Canutillo, 9 Aug. 1951, on *Guardiola tulocarpa* Gray (Evans); TEXAS: 1 ♀, Laredo, 25 May 1944, on human (U. S. Nat. Mus.); 1 ♀, El Paso, 16 June 1944, "Mexico City via Monterrey, Anderson Field" (U. S. Nat. Mus.); CALIFORNIA: 2 ♀ ♀, Potwisha, Sequoia Nat. Park, June (E. C. VanDyke).

Allaporus toltecus new species

Although I have but one specimen of this form, a male, it seems sufficiently unusual to warrant description at this time. The bluish pubescence and abundant dark setae on the body are unusual features in this genus.

Male. Length 6 mm.; fore wing 5.8 mm. Color black; wings lightly, rather evenly infuscated. Pubescence on the scape, lower front, clypeus, temples, front and sides of the pronotum, lower margin of the mesopleura, all the coxae, and posterior slope of the propodeum, conspicuously silvery; elsewhere the pubescence is dark and prominently bluish-refulgent. Scape below with numerous long dark setae; clypeus, front, vertex, temples, thoracic tergites and pleurites, propodeum, all the coxae, trochanters, and to some extent the femora, with erect dark setae of moderate length and in considerable abundance. Mandibles simple; malar space of moderate length, as long as the pedicel. Front of considerable breadth, the middle interocular distance .7 the transfacial distance; upper interocular distance 1.2 times the lower interocular. Postocellar and ocello-ocular lines equal; posterior ocelli about their diameters from the vertex crest, which is much less acute than in the preceding two species. First four antennal segments in a ratio of about 10:4:6:9; segment three 1.2 times as long as thick.

Posterior margin of pronotum with a slight median notch. Longer spur of hind tibia .7 the length of the basitarsus. Wings as shown in Fig. 2; second submarginal cell 1.5 times as broad as high; third discoidal cell 1.3 times as broad as high. Sixth abdominal sternite with a large, somewhat rectangular apical emargination. Subgenital plate rather broad, slightly less so than in *mexicanus,* which is shown in Fig. 10. Genitalia very similar to those of *rufiventris;* parameres slender, with parallel margins, considerably shorter than the digiti, the latter with very small setae, the apical fourth bare (Fig. 8).

Holotype. ♂, Teotihuacán Pyramids, about 30 miles northeast of Mexico City, state of MEXICO, 15 June 1951 (P. D. Hurd) [Univ. Calif.].

A NEW SPECIES OF CHIGGER FROM EASTERN KANSAS (Acarina, Trombiculidae)[1] [2]

RICHARD B. LOOMIS AND D. A. CROSSLEY, JR.

In the course of investigations to determine the species of chiggers infesting reptiles, a number of small yellow larvae, *Trombicula sensu lato,* were found attached on three of four adult greater five-lined skinks, *Eumeces laticeps* (Schneider), which were taken in a deciduous bottomland forest habitat, in extreme eastern Kansas. This species is described as follows:

Trombicula trisetica new species

Diagnosis: — A larval *Trombicula* characterized by a bifurcate palpal claw, axial prong internal (and ventral); scutum roughly rectangular; sensillae flagelliform with 8 to 10 distinct distal branches preceded by a few short barbs; galeal seta nude; one mastitarsala III[3]; three, occasionally four, setae on coxa III; three pairs of sternal setae; and eight dorsal body setae in the first row (excluding humerals).

Body: — Length and width of body of holotype 358 by 275 microns[4] (partially engorged); engorged specimen 438 by 380. Color in life, yellow. Eyes, two on each side, subequal, bright red in life; ocular plate obscure; distance across both eyes of one side 19, in holotype.

Gnathosoma: — Chelicera long and slender, slightly curved; one prominent dorsal tricuspid cap; basal segment approximately two thirds as wide as long; base punctate. Galeal seta nude. Capitular sternum with one pair of branched setae. Palpal femur with one branched seta, two to three branches; genual seta with single branch; three tibial setae with about three branches on each; tarsus with single basal spur (6μ), one stout feathered seta, and four branched setae, the basal seta with four to five branches, the other three with single branches. Palpal claw bifurcate, the prongs nearly equal in length, with the inner prong being axial, ventral, and curved slightly inward.

Scutum: — Shape of scutum roughly rectangular, posterior margin convex, posterolateral margin slightly emarginate just anterior to base of posterolateral seta, converging anteriorly to a nearly straight anterior margin. Scutum with small, numerous punctae. Posterolateral setae longer than anterolateral setae. Sensillae flagelliform with eight to ten long branches on distal half, a few short barbs on proximal half. Bases of sensillae situated nearly equidistant between the anterior and posterior margins, and nearly parallel to the midpoints between antero- and posterolateral setae. Standard measurements for holotype: AW-48, PW-59, SB-17, ASB-25, PSB-23, AP-23, AM-25, AL-21, PL- 30, S- 50. Average of ten specimens and extremes (paratypes): AW- 49 (46-51), PW- 61 (59-63), SB- 18 (15-20), ASB- 25 (24-27), PSB- 23 (22-23), AP- 21 (19-23), AM- 25 (23-27), AL- 22 (20-26), PL- 30 (28-35), S- 49 (46-50).

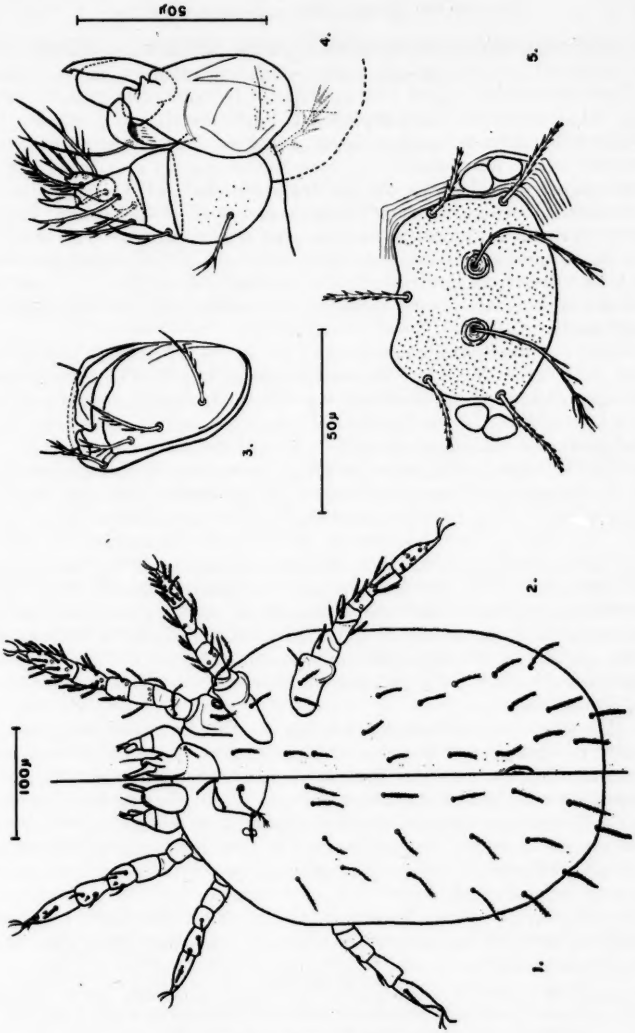
Legs: — Leg I coxa, trochanter, and basifemur each with one branched

[1] The studies upon which this paper is based were conducted under a contract, N6 ori 220 Task Order II, between the University of Kansas and the Office of Naval Research.

[2] Contribution No. 797 of the Department of Entomology, University of Kansas.

[3] Terminology used throughout this paper is that of Wharton, *et al,* 1951.

[4] All measurements are in microns.



EXPLANATION OF PLATE I

Trombicula trisetica

Fig. 1. Dorsal aspect of larva, showing sensory setae on legs.
Fig. 2. Ventral aspect of larva, showing branched setae on legs.
Fig. 3. Coxa III showing four setae.
Fig. 4. Dorsal aspect of gnathosoma (holotype).
Fig. 5. Scutum and eyes (holotype).

seta; telofemur with five branched setae; genu with four branched setae, three genualae, and one microgenuala; tibia with eight branched setae, two tibialae, and one microtibiala; tarsus with approximately twenty-two branched setae, spur (11μ), microspur, parasubterminala, subterminala and pretarsala. Leg II coxa and trochanter each with one branched seta; basifemur with two branched setae; telofemur with four branched setae; genu with three branched setae and one genuala; tibia with six branched setae and two tibialae; tarsus with sixteen to twenty branched setae, spur (12μ) and microspur. Leg III coxa with three (occasionally four) branched setae; trochanter with branched seta, basifemur with two branched setae; telofemur with three branched setae; genu with three branched setae and one genuala; tibia with six branched setae and one tibiala; tarsus with approximately twelve branched setae and one mastitarsala.

Setae: — Dorsal setal formula: 2-8-6-6-6-4-2, total 34; humeral seta measures 36; anterior dorsal seta 29; posterior dorsal seta 28. Ventral setal formula: approximately 2-2-2-6-6-6-6-4-2, total 34 to 38; anterior sternal seta measures 20; third sternal seta 18; anterior ventral seta 18; posterior ventral seta 25. Counts were taken from partially engorged specimens.

Type material: — Holotype and 25 paratypes from Miami County, Kansas, 3 miles east, 1 mile south of Fontana, in the Pigeon Lake area, found on three adult female greater five-lined skinks, *Eumeces laticeps,* Univ. Kansas Mus. Nat. Hist. nos. 30521-2 (field no. RL510526-3) collected by R. B. Loomis and Olin L. Webb, May 26, 1951; holotype, slide number 3004; paratypes, nos. 3001-3003, 3005-3026. The holotype and 13 paratypes are deposited in the Snow Entomological Collections, University of Kansas. Two paratypes will be sent to the Rocky Mountain Laboratory, the United States National Museum, the British Museum (Natural History), Duke University, the South Australian Museum, Adelaide, and the Muséum National d'Histoire Naturelle, Paris, France.

Remarks: — *Trombicula trisetica* does not fall into any of the named subgenera of *Trombicula.* It seems to be related to *Trombicula montanensis* Brennan, 1946, and probably *Trombicula nativitatis* Hoffmann, 1950, on the basis of three (or more) setae on coxa III and one mastitarsala III. *Trombicula trisetica* is readily separated from those species mentioned above on the basis of its three pairs of sternal setae. In the type series of 26 specimens, 20 have three setae on both coxae III, 4 have four setae on one side only, and 2 possess four setae on both coxae III.

Acknowledgments:—The writers wish to thank Mr. Louis J. Lipovsky and Dr. Charles D. Michener of the University of Kansas for carefully checking the manuscript.

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NOTES ON THE MELECTINE BEES OF MEXICO (Hymenoptera:Anthophoridae)

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The present paper is an attempt to summarize the distributional knowledge of the Melectine bees as occurring in Mexico and to examine this fauna in the light of the New World occurrence of the tribe Melectini (as defined by Michener, 1944:286-287). Of considerable assistance in the interpretation of the New World Melectine bee fauna are the distributional records obtained in Mexico by the David Rockefeller Mexican Expedition of the American Museum of Natural History and the Evans-Hurd Mexican Expedition sponsored by the American Philosophical Society and the Associates in Tropical Biogeography of the University of California.

The American bees of this group were revised by Linsley (1939) with subsequent additions by that writer in 1943 and by Michener (1948). These papers have indicated that the known distribution of these bees in North America is anomalous. Hurd and Linsley (1951), in a study of the California Melectine bees, have intimated that the rather unusual distribution of the group in the western hemisphere may be due to a polyphyletic grouping of the various elements.

At present the New World species are assigned to four genera, *Melecta, Xeromelecta, Zacosmia,* and *Brachymelecta.* Of these *Xeromelecta, Zacosmia,* and *Brachymelecta* are of primarily austral distribution, being found chiefly in the western portion of North America (fig. 1). The genus *Melecta* contains six species in North America and appears to be largely boreal, having differentiated primarily in the principal cordilleran regions of western North America. One western species has apparently differentiated in the Upper Sonoran zone of coastal California and appears to be subgenerically distinct from *Melecta, s.s.,* and has been assigned to the monotypic subgenus *Melectomimus.* On the basis of present records the genus *Melecta* is discontinuous in its North American distribution being represented in the western United States by five species and in the eastern United States by one species *M. atlantica* Linsley which is very closely related to *M. pacifica* Cresson. The southern terminus of the genus in western North America, while imperfectly known, would appear to be in the mountainous regions of northern Mexico. One species *Melecta (Melectomimus) edwardsii* Cresson has been found at Tiajuana, Lower California, and the presently known southern distributional peripheries of at least two other species, *Melecta pacifica* Cresson and *M. separata* Cresson suggest the probable occurrence of these species in northern Mexico.

The genus *Xeromelecta* contains three subgenera, *Xeromelecta, s.s., Melectomorpha,* and *Nesomelecta.* The nominotypical subgenus is represented by one species *larreae* (Cockerell) which is apparently restricted to the deserts or more arid regions of the western United States, and it is likely that future collecting in Mexico will demonstrate its occurrence in the northwestern regions of that country. The subgenus *Melectomorpha* includes two species, *californica* (Cresson) and *interrupta* (Cresson). In distribution *californica* ranges

from British Columbia and South Dakota southward to Tehuacán in the state of Puebla, Mexico near 18° 30′ north latitude (the southernmost point in continental North America now known for the group) and from the Mississippi River westward to the Pacific coast. The specific localities in Mexico are: 20 miles north of Mesquital, Lower California, 3 ♂, IX-27-47, E. S. Ross & G. E. Bohart; Fresnillo, Zacatecas, 7000 ft., ♀, VIII-15-47, C .D. Michener (Michener, 1948:17); Guadalupe, Zacatecas, ♀, VIII-17-47, C. D. Michener; Tehuacán, Puebla, ♀, on *Eysenhardtia polystachya,* VI-23-51, H. E. Evans, ♀, same data P. D. Hurd. The species *interrupta,* previously unrecorded from Mexico, ranges from Minnesota southward to Sombrerete in the state of Zacatecas, Mexico, and from the Mississippi River westward to the Rocky Mountains. Specific locality records in Mexico are: 15 kilometers east of Sombrerete, Zacatecas, ♀, VII-29-51, P. D. Hurd, at flowers of *Baccharis;* Nombre de Dios, Durango, ♂ ♀, VIII-6-51, P. D. Hurd, at flowers of blue aster; Santa Clara, Chihuahua, 14 ♀, VII-2-47, C. D. Michener.

The subgenus *Nesomelecta* contains two species, *pantelon* (Dewitz) from Porto Rico and *haitensis* (Michener) from Haiti. C. D. Michener *(in litt.)* tells me that he has specimens of a third species from Cuba. These species represent the southernmost occurrence in the New World of the Melectine bees.

Generic distribution of the American Melectine bees. *Melecta* indicated by dashed line; *Xeromelecta* by solid line (its subgenus *Nesomelecta* by solid line crossed by a series of x's); and *Zacosmia* by dotted line.

The genus *Zacosmia,* with two nominal species, *maculata* (Cresson) and *suffusa* (Viereck), is restricted in its distribution to the New World and is apparently distributed in the austral regions of western North America ranging from Alberta southward through the Great Basin to the desert regions of California with an extension northwestwardly into the more arid regions of the San Joaquin Valley of California, also occurring in coastal southern California, northern Lower California, eastward through Arizona, New Mexico and as far south as Juarez, Chihuahua, Mexico.

The monotypic genus *Brachymelecta* is known from a single specimen collected in Nevada. Its relationship appears to be very close to *Zacosmia.* A recent re-examination of the type of *Brachymelecta mucida* (Cresson) by C. D. Michener confirms the fact that it is a male, quite distinct from *Zacosmia.* One of its distinctive features not mentioned in previous descriptions is the conspicuously bilobed apex of the last abdominal tergum.

The Mexican Melectine bee fauna appears to consist chiefly of species of austral distribution. *Melecta,* a largely northern and more boreal group, apparently is absent from the principal cordillera of Mexico, except perhaps in the northern mountains of that country. *Zacosmia* probably occurs at least as far south as Durango in central Mexico, although the records to substantiate this are lacking. The two species of *Xeromelecta (Melectomorpha)* are now known to occur as far south as central Mexico (Puebla and Zacatecas) and it is not unlikely that the genus will be found in other Central American countries and possibly northern South America.

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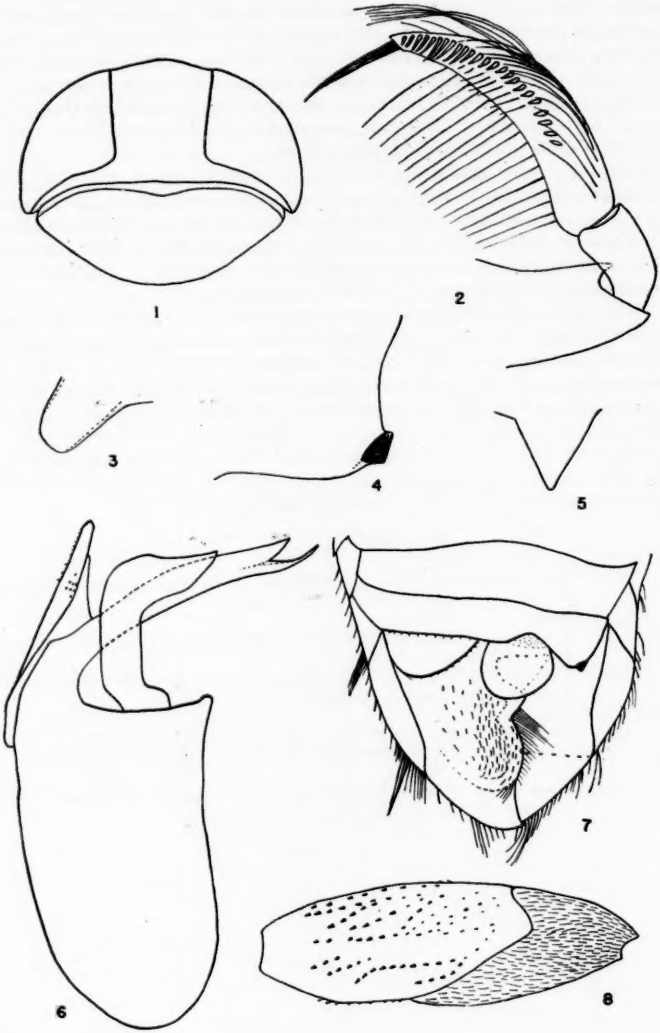
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A NEW AGRAPTOCORIXA FROM NEW GUINEA (Corixidae-Hemiptera)[1]

H. B. HUNGERFORD
Lawrence, Kansas

Agraptocorixa macrops n. sp.

Size: Length 7.77 mm. — 7.79 mm.; width across head 2.625 mm. — 2.73 mm.

Color: General color rather dark due to the numerous large brown punctures on pronotum and hemelytra. Vertex and face more or less embrowned. Venter of male abdomen usually brown to nearly black, dorsal abdominal surface dark in both sexes.

Structural characteristics: The striking characteristics of this species are the large protuberant eyes with their surface more convexly rounded than normal, the relatively narrow interocular space which is less than the width of the eye, the wide postocular space, the long head, the short pronotum which is shorter than the head and the short non-functional flight wings which are probably associated with the reduced pronotum. The hemelytra lack the postnodal pruinose area. The face in both sexes is broadly flattened, plainly concave and covered with long hair. The palae are elongate with a definite carina on the outer surface near the dorsal margin. The male pala with twenty pegs, the two basal pegs small, the distal ones long. The metaxyphus as long as wide. Male strigil small, triangular of four or five rows of striae, connected to the outer end of a black sclerotized margin of the right lobe of the sixth abdominal segment. The male genital parts as shown in the drawings.

Location of types: Described from Holotype, allotype and 22 male and 32 female paratypes labeled "Museum Leiden, Nieuw Guinea Exp. K. N. A. G. 1939, Paniai 3. 1x, 1939" — Holotype, allotype and some paratypes in the Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands. Other paratypes in the Snow Entomological Collection.

A. macrops

Comparative notes: This form has been compared with all the species described from the Australasian area. It appears to be more nearly related to *A. eurynome* Kirk. than to the others but the rounded eyes, the narrow interocular space and the broad postocular area readily separate it from that species.

[1] Contribution No. 811, Department of Entomology, University of Kansas

Plate of *Agraptocorixa macrops*

1. Head and pronotum
2. Front leg of male
3. Left lateral lobe of prothorax of male
4. Male strigil enlarged
5. Metaxyphus
6. Genital capsule of male
7. Abdominal dorsum of male
8. Ventral view of right hind femur of male

SYNONYMICAL DATA AND DESCRIPTION OF A NEW HYDROMETRA (Hemiptera:Hydrometridae)

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The present paper describes a new species of the Genus *Hydrometra* Lemarck from Paraguay and suppresses *Hydrometra husseyi* Bueno, *H. kirkaldyana* Bueno, and *H. chilensis* (Reed) as synonyms of *H. argentina* Berg. In order to straighten out confusion, a complete bibliography is given for *H. argentina.*

Hydrometra placita, sp. new

Moderately long, moderately stout, brownish, the abdomen beneath a little paler and slightly frosted. Length, 12.20 mm.

Head: Length, 3.10 mm. Anteocular part scarcely more than twice as long as posterior part (94:45). Interocular groove above rather shallow, not extending beyond front and hind margins of eyes; ventral groove shallower and shorter. Rostrum long, extending slightly beyond middle of postocular part. Antennae long, slender, the basal segment moderately stout and darker; unit length of segments — I, 24; II, 42; III, 125; IV, 80. Clypeus narrow, brown, convex above, the apex rather narrowly sharply rounded.

Pronotum (short-winged form): Length, 1.76 mm. Anterior part without pits, except for the encircling row of small pits paralleling and setting-off a narrow front collar; hind part as long as front part, becoming narrower posteriorly, pitted, the pits very large, very shallow and somewhat evanescent. Hemelytra very short, straplike, dark brown, reaching the middle of mesonotum. All acetabula and propleura without punctures.

Legs: Legs very long, slender, brownish. Anterior femora 6.20 mm. long, with tips scarcely attaining apex of head. Hind femora 9.35 mm. long, with apices attaining extremity of abdomen.

Abdomen: Length, 9.20 mm. Connexiva yellowish brown with outer margin narrowly margined with fuscous; tergites shinning. Female genital segment terminating in a short straight spine, which is pointed posteriorly. Male and longwinged forms unknown.

Type (female) and *paratype* (female), Horqueta Paraguay, Nov. 20, 1940, Alberto Schulte, in my collection.

This species is very similar in appearance and size to *H. comata* Bueno, but it can be separated from it by the pits on all acetabula and propleura and the narrow clypeus. In *H. comata* the clypeus is unusually broad and medially excised, also the hind lobe of the pronotum is unpunctured.

Hydrometra argentina Berg

Hydrometra argentina Berg, Hemip. Arg., 1879, p. 184.
Limnometra chilensis Reed, Rev. Chil. Nat., 5:197 (reprint, p. 103), 1901. (New Synonymy).
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Hydrometra husseyi Bueno, Entom. Amer., 7(NS2):111-115. 1926. (New Synonymy).
Hydrometra argentina Bueno, Entom. Amer., 7(NS2):125-126. 1926.

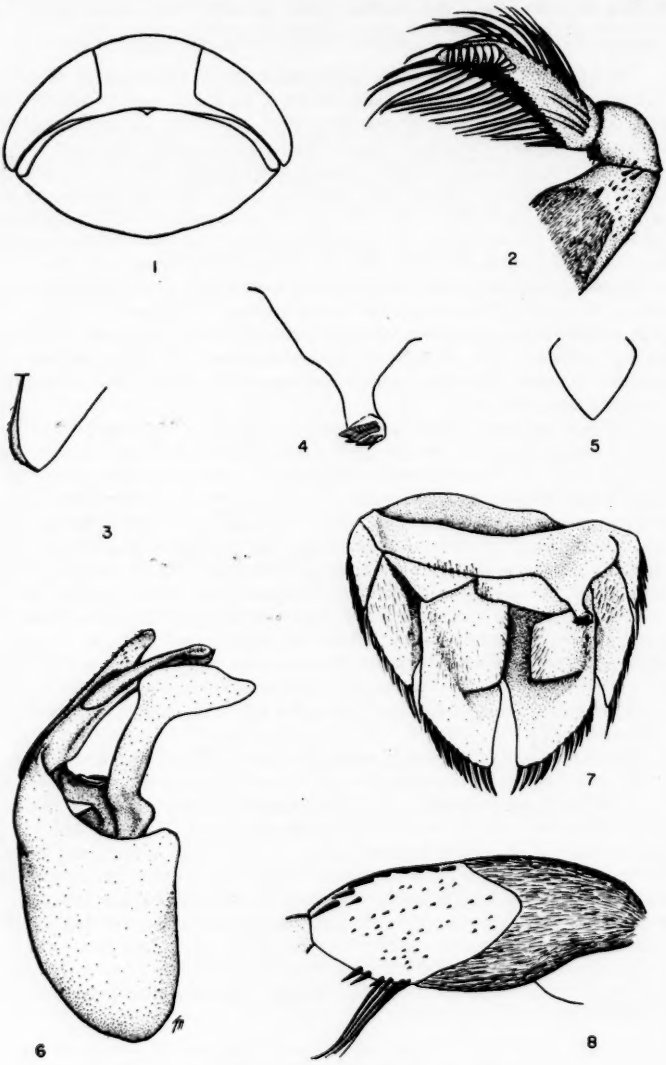
Hydrometra argentina Bueno, Entom. Amer., 7(NS2):125-126. 1926.
Hydrometra chilensis Bueno, Entom. Amer., 7(NS2):126. 1926.
Hydrometra husseyi Hungerford and Evans, Ann. Mus. Nat. Hist. Hung., 28:105. 1934.

The type of *H. argentina* Berg is a winged female (not male as stated in original description) in the La Plata Museum, La Plata, Arg. In addition to the type, many males and females have been seen from Argentina, Chile, Paraguay, Uruguay, Bolivia, Peru and Brasil. It is a rather active species for a marshtreader, and inhabits both running and standing waters. The middle and fore acetabula are pitted, each acetabulum normally having one pit on each side of the cleft. The hind acetabula are unpunctured. The propleural and acetabular pits are small. The punctures on the hind lobe of the pronotum are very large, very shallow and at times more or less obscure and difficult to see. In examining long series of specimens, individuals were found that had some or even all of the pronotal pits obscure and not visible under the microscope without first wetting the pronotal surface. The male processes are spine-like (one on each side) and placed close to the front margin of the last segment of the venter. The first male genital segment is deeply and broadly impressed on each side.

The type series of *Hydrometra chilensis* (Reed) is represented by three males and one female. A short-winged male, which bears a label *"Limnobates chilensis* Reed" written in Reed's handwriting, is selected as the *type* and a long-winged female as the *allotype*. The two remaining specimens, short-winged males, are paratypes. These specimens tend to be slightly shorter than most specimens of *H. chilensis* from Chile, but they fall within the range of variation in size. As there are no structural differences between *H. argentina* and *H. chilenses,* the latter is here placed in synonymy. (New synonymy).

After examining specimens of *H. argentina* Berg in the Paris Museum, Hungerford and Evans (1934, p. 105) stated that *H. husseyi* Bueno was probably equal to *H. argentina* Berg. As the writer has compared specimens of *H. husseyi* (det. by Bueno) with the type of *H. argentina,* it is necessary to follow Hungerford's suggestion and place the name of *husseyi* in synonymy. (New synonymy).

After examining the allotype and a paratype of *H. kirkaldyana* Bueno, it is also necessary to synonymize this name with *H. argentina.* (New synonymy). In the above two examples of the type series, the fore and middle acetabula are pitted as in *H. argentina,* also the propleura. The male and female are the same as in *argentina;* and, when the hind lobe of the pronotum is moistened with alcohol or some other wetting agent, the large shallow pits become plainly visible. Typical specimens of *H. kirkaldyana* can be found in long series of specimens of *H. argentina;* and as in the types, wetting the pronotal surface brings out the shallow punctures. The confusion and synonymy as listed above is due largely to the fact that the species described by Berg and Reed were unknown to Hemipterists for many years after the species were described.



AGRAPTOCORIXA HALEI HUNGERFORD

A NEW AGRAPTOCORIXA FROM AUSTRALIA[1]

H. B. HUNGERFORD
Lawrence, Kansas

In 1928 Dr. O. Lundblad[2] published a splendidly illustrated paper on the Australian species of the genus Agraptocorixa. At that time there were known only three species from Australia — *A. eurynome* (Kirk.), *A. parvipunctata* (Hale) and *A. hirtifrons* (Hale). I am now able to add a fourth species which I name in honor of H. M. Hale who has described a number of Australian Corixidae.

Agraptocorixa halei n. sp.

Size: Length 6.72 mm. to 7.56 mm. Width across head 2.52 mm. to 2.73 mm.

Color: Medium brown, the yellowish pronotum and hemelytra thickly covered with small setiferous brown punctures. Head, legs and thoracic venter yellowish. Abdominal venter of males usually dark.

Structural Characteristics: A little larger and broader than *A. parvipunctata* (Hale), the anterior margin of the head, as seen from above, more curved than in *A. parvipunctata,* so that the head is longer compared with the pronotal disk than in the latter species. Head length compared with pronotal disk:: 3:5. Interocular space nearly as wide as an eye (4.5:5) Face of male flattened and slightly excavated, sparcely covered with fine inconspicuous depressed hairs. Disk of pronotum and hemelytra thickly covered with small setiferous brown punctures. The hairs are short, dark brown and depressed, those in the pronotum shorter and less conspicuous than those on hemelytra, much as in *A. eurynome* (Kirk.) but the brown spots are more numerous and closer together. The male pala elongate with a ridge on the outside near the upper margin and a row of nine or ten pegs on the inside as shown in a figure 2. The lateral lobe of the pronotum broader at base that at tip which is broader than the mesoepimeron. Metaxyphus broader than long. The male strigil at the end of an extension of the sixth segment and consisting of three striae. The genital capsule as shown in figure 6, the right clasper quite distinctive.

Location of types: Described from Holotype male, bearing the label "N. Queensland, Australia, Barren river, Near Barren waters, 9-28, 1938 R. G. Wind.", allotype labeled "Townsville, N. Queensland, Australia G. F. Hill,

[1] Contribution No. 813, Department of Entomology, University of Kansas.

[2] Lundblad, O. Die Australischen Arten der Gattung Agraptocorixa. Arkiv För Zoologi Band 20 A. No. 6. pp. 1-19. (with 13 text figures and two plates.)

Plate of *Agraptocorixa halei*

1. Head and pronotum
2. Front leg of male
3. Left lateral lobe of prothorax of male
4. Male strigil enlarged
5. Metaxyphus
6. Genital capsule of male
7. Abdominal dorsum of male
8. Ventral view of right hind femur of male

Collr. 1920", and 3 ♂ ♂, 1 ♀ paratypes labeled like the allotype. (In the Frances Huntington Snow Collection, University of Kansas.)

In addition there are: 2 ♀ ♀ paratypes labeled "Townesville Australia, B. Malkin, Jan. 1945" (1 ♂, 2 ♀ ♀ in U. S. N. M. and 1 in F. H. S. Coll.); 3 ♂ ♂, 3 ♀ ♀ labeled "Townville, Q. Mar. 1932. Australia, Harvard Exp. Darlington." (2 ♂ ♂, 2 ♀ ♀ in Museum Comp. Zoology, Harvard and 1 ♂, 1 ♀ in F. H. S. Collection.)

Comparative notes: This species agrees with *A. parvipunctata* (Hale) in having the male strigil on a projection but has a strikingly different right clasper. The four Australian species, now known may be separated by the following key.

Key to Australian Agraptocorixa

A. Faces of both sexes typically densely covered with hair, the pruinose area of ventral side of hind femur reduced not extending beyond the basal fifth on the anterior margin. *A. hirtifrons* (Hale)

AA. Not as above.

B. Male with palar peg row long and containing more than twenty pegs. ..... *A. eurynome* (Kirk.)

BB. Male peg row short containing not more than a dozen pegs.

C. Distal half of the right clasper broadly expanded ..... *A. halei* n. sp.

CC. Distal half of the right clasper not expanded ..... *A. parvipunctata* (Hale)

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